SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER 1904.

GENERAL PHYSICS.

3151. *A Differentiating Machine.* **J. Erskine-Murray.** (Roy. Soc. Edinburgh, Proc. 25. pp. 277–280, 1903–1904.)—A machine which automatically deduces the rate of change of a function from the curve representing that function is desirable both to illustrate mathematical laws where the form of the function is expressible by an equation, and to deal with the ever-increasing mass of numerical results awaiting discussion and co-ordination. Among the latter class are mentioned: (1) Meteorological records of temperature, pressure, humidity, and rainfall. (2) Magnetic records. (3) Statistics of population, mortality and migration, wages and prices. (4) Engineering calculations, such as deduction of tractive force from a time and speed diagram. The construction of the differentiator depends on the well-known fact that if the values of a variable quantity are represented on a diagram by the ordinates of a curve, its rate of change, at any point of the curve, is measured by the slope of the tangent at that point. The machine, then, is guided by hand so that one line on it remains a tangent to the curve, while a tracing point describes on a second sheet of paper a curve whose ordinates are proportional to the slope of the tangent. Thus if the original curve be $y=f(x)$, the derived curve will have for ordinates the corresponding values of dy/dx. The abscissæ are the same on both curves. The details of the machine are fully described by references to two figures. E. H. B.

3152. *Variations of Errors in Graduated Circles.* **G. Bigourdan.** (Comptes Rendus, 139. pp. 513–515, Sept. 26, 1904.)—Much trouble has often been caused by the variability found in the minute graduation errors of the delicate circles used by astronomical institutions. In most cases the divisions are engraved on a strip of silver inlaid along the circumference of a massive brass or iron circle, and the author announces that he can account for the discrepancies found by regarding them as due to temperature variations. Examples of the dilations produced by the yearly range on a metre circle are given. Iron circles will exaggerate the effect, while with silver on brass circles it is much smaller. It is suggested that the best solution of the difficulty would be to discontinue the use of an inlaid silver band, and engrave the divisions directly on the metal composing the frame; either nickel or one of the nickel-steel alloys might be found to fulfil the necessary requirements as to rigidity, polish, permanence and clearness of cut under the engraving tool. C. P. B.

3153. *Skate Instrument for Integrating and Determining Moments.* **J. Schnöckel.** (Zeitschr. f. Math. u. Phys. 49. p. 372, 1903. Abstract by **Hammer** in Zeitschr. Instrumentenk. 24. pp. 245–246, Aug., 1904.)—A ruler of celluloid, 25 cm. in length, has two bevelled edges. The one edge is divided in divisions of (1/150) m., the marking proceeding from the middle point A of the edge to both ends; the other edge is divided from its middle point B to the left in divisions of (1/150) m., to the right in divisions of double the length, (1/75) m. In the middle between A and B is the skate, with its edge parallel to the ruler edges. To integrate a curve the ruler is so guided along the curve that the point A at any moment bisects the length of the ruler, intercepted between the respective point of the curve and a directrix. When the ruler is similarly guided in such a way that the point B cuts the length intercepted in the ratio 2 : 1, the static moment will be found. With another ruler whose divisions are in the ratio 3 : 1 the moment of inertia can be found, and the instrument can determine any integral of the form $\int y^n dx$, where n has any positive or negative value. The position of the skate is not the same in all the cases. H. B.

3154. *Manufacture and Repair of Quartz Articles.* (Elect. Rev. 55. p. 560, Sept. 30, 1904.)—P. Askenasy, of Pansdorf, near Liegnitz, has patented a method of producing or repairing quartz articles. He places a quantity of quartz sand on a support of the same material, and fuses it into the desired shape by an electric arc, which is moved over the surface to be melted. If a basin has to be made the sand is first mixed with 1 per cent. starch solution or like material. The arc is struck between sloping electrodes of small diam., high voltages being employed, and the operation is conducted in an atmosphere of CO. In certain cases it may be desirable to add to the sand some metallic oxides like alumina, stannic acid, titanic acid, &c., which lower the melting-point, but the quantity must be small or the coefficient of expansion will be seriously affected. During the fusion a dust of quartz may be allowed to fall round the arc so that any holes produced are instantly sealed up. The same process is available for the repair of any crack or flaw in already constructed articles. W. W. H. G.

3155. *Viscosity and Composition of some Colloidal Solutions.* **H. Garrett.** (Phil. Mag. 6. pp. 374–378, Sept., 1903. Extract from Inaugural Dissertation, Heidelberg, 1903.)—The viscosity of solutions of gelatine, silicic acid and albumen was deduced (1) from the damping of the oscillations of a disc vibrating in the liquid, and (2) from the flow of the liquid through a capillary tube. The results were inexplicable on the older theory of colloids, but agreed well with Quincke's "foam-cell" theory. On this theory the colloidal solution is not homogeneous, but consists of a mixture of two solutions having surface tension at the surface of contact, one rich in colloid the other poor in colloid; the richly colloidal solution forms itself into cells which may be full of the poorer solution or of uniform composition, and may be grouped into threads and masses. This theory is necessary to explain observations such as the following: (1) The logarithmic decrement for a disc oscillating in a solution of gelatine is very variable even under apparently identical conditions, and depends on the time during which the disc has been soaked in the liquid. A regular minimum value is obtained when the disc is freshly immersed in the liquid, but the decrement then increases in a linear manner with the time. (2) Occasional disturbances create immense irregularities in the decrement given by gelatine solutions, but not by homogeneous liquids. (3) The logarithmic decrement in a dilute solution was smaller with large than with small swings, and the oscillating disc gave much higher values for the viscosity than the transpiration method. All these results can be explained by the clinging of the "foam cells" to one another and to the disc, but no analogous phenomena occur in homogeneous non-colloidal liquids, and the observations are regarded as evidence that colloids are non-homogeneous liquids. T. M. L.

3156. *Elasticity of Indiarubber.* **J. C. Shedd** and **R. L. Ingersol.** (Phys. Rev. 19. pp. 107–116, Aug., 1904.)—The purpose of the experiments described was to extend the stretching force over a much greater range than hitherto, and to study the elastic after-effect. In the first apparatus a common rubber band was used, and the extensions were observed by a cathetometer. Readings were taken both with rising and falling loads. Experiments were also made when the rubber was heated up to 93° C. The result of plotting the observations shows viscosity loops. These loops must be due to the irreversible action of viscosity, and the area of the loop (as in the case of the hysteresis of iron) is a function of the energy absorbed. The study of these loops seems to make two definitions of the elastic limit possible. In the first place, on the rising curve there is seen to be a more or less well defined "knee" where the relation of stress to strain undergoes a marked change. This "knee" might be said to mark the elastic limit. A second definition of the elastic limit can be given as follows: "The elastic limit is the limiting value of the stress (or strain) for which the body upon being released will repeat its previous history in exactly reversed order." The history of a cycle may be divided into the following parts: (A) The first part of the curve has a small slope showing an apparently high value for the elastic modulus E. This in a measure corresponds to the early stage of the magnetisation of iron. (B) The second stage shows a comparatively constant but smaller value of E. (C) In the third stage the curve bends, showing a very high value of E. During this stage the rubber is in an abnormal state, behaving like a metallic wire. This stage ends abruptly by the breaking of the rubber, or else it receives a permanent set, as shown by the descending curve. A consideration of the viscosity loop also affords a partial explanation of the behaviour of rubber that has long been a striking experiment, namely, that a loaded rubber tube will shorten when steam is passed through it; this is due not so much to an increase in the elastic modulus as to a rise in the elastic limit.

W. W. H. G.

3157. *Viscosity of Oxygen, Hydrogen, Chemically Produced and Atmospheric Nitrogen, and its Change with Temperature.* **H. Markowski.** (Ann. d. Physik, 14. 4. pp. 742–755, Aug. 2, 1904. Extract of Hallenser Dissertation.) —The apparatus used by the author is described in Ann. d. Phys. 5. 1901. The preparation of the gases and the filling of the apparatus are described. The results for the coefficient of viscosity are corrected for slipping, the corrected results for air being $\eta_{15\cdot9} = 1814 \times 19^{-7}$, and $\eta_{99\cdot62} = 2212 \times 10^{-7}$, which are in good agreement with those of H. Schultze [see Abstract No. 1616 (1901)]. The determination of the coefficient of viscosity at different temperatures shows that the temperature coefficient decreases with rising temperatures except in the case of hydrogen. For the gases examined the agreement over a range of 0° to 183° C. with Sutherland's formula is very good, and the coefficient of viscosity of atmospheric nitrogen is accurately calculable from those of argon and chemically prepared nitrogen. S. G. S.

3158. *Diffusion of Argon and Helium.* **R. Schmidt.** (Ann. d. Physik, 14. 4. pp. 801–821, Aug. 2, 1904. Extract from Inaugural Dissertation, Halle, 1904.)—The Maxwell-Loschmidt method is employed, the apparatus consisting of diffusion cylinders about 100 cm. long, with special stopcock arrangements. The argon is prepared by the Ramsay-Travers method, and the helium by a method of Schultze's. The value of the diffusion coefficient for these two gases is found to be about 0·254. Comparison with Meyer's theory is given. J. W. P.

3159. *On the Transformation of Energy (Energieumsatz) in Mechanics.* **G. Zemplén.** (Ann. d. Physik, 13. 4. pp. 840–847, March, 1904.)—This paper is in continuation of a former one by the author [see Abstract No. 467 (1904)]. It concerns Ostwald's principle, or supposed principle, of maximum "Energieumsatz," the existence of which has been doubted (see Förster, Zeitschrift für Mathematik und Phys. 49. p. 84, 1903, referred to by the author in this paper). To make the present paper intelligible the reader must turn to the former one, pp. 424, 425, where the writer considers the case of a mass m constrained to move on a surface $\phi=0$. It is subject to forces X, Y, Z. Its velocities are, at time t, u, v, w ; at time $(t+\tau), \bar{u}, \bar{v}, \bar{w}$; and by application of the supposed principle the writer obtains $X+\rho\frac{d\phi}{dx}=mu\frac{d}{dt}\log T$, with two corresponding equations, in which ρ is a certain constant, and T kinetic energy, instead of the usual equations, $X=m\frac{du}{dt}$, &c. But now, since the particle is, *ex hypothesi*, moving on the surface at time t, and at time $(t+\tau)$, we have—

$$u\frac{d\phi}{dx}+v\frac{d\phi}{dy}+w\frac{d\phi}{dz}=0 \ldots\ldots\ldots\ldots (a),$$

$$\bar{u}\frac{d\phi}{dx}+\bar{v}\frac{d\phi}{dy}+\bar{w}\frac{d\phi}{dz}=0 \ldots\ldots\ldots\ldots (b),$$

and

$$X\frac{d\phi}{dx}+Y\frac{d\phi}{dy}+Z\frac{d\phi}{dz}=0 \quad \ldots\ldots\ldots\ldots (c),$$

X, Y, Z including the surface reactions, if any. Now at p. 424 multiply equations (3), (4), (5) by $\frac{d\phi}{dx}, \frac{d\phi}{dy}, \frac{d\phi}{dz}$ in order, and add, taking account of (*a*), (*b*), (*c*), and we get $\mu\left(\left(\frac{d\phi}{dx}\right)^2+\left(\frac{d\phi}{dy}\right)^2+\left(\frac{d\phi}{dz}\right)^2\right)=0$, therefore $\mu=0$, therefore $\rho=\frac{2\mu}{\lambda}$ (p. 424) $=0$. The final equations are therefore $X=mu\frac{d}{dt}\log T$, $Y=mv\frac{d}{dt}\log T$, $Z=mw\frac{d}{dt}\log T$. The supposed principle, as applied to the case of a moving particle, whether constrained to move on a surface or not, shows only that the greatest possible transformation of energy is when $X:Y:Z::u:v:w$, which is true, but not new. Whether its application to other cases may or may not produce new and important results does not appear in the present paper. S. H. B.

3160. *Density of Nitrous Oxide.* **Rayleigh.** (Roy. Soc., Proc. 74. pp. 181–183, Sept., 1904.)—A repetition of earlier experiments on this subject but further purifying the gas by means of liquid air, has failed to raise the weight higher than 3·63653, or 0·2 mgm. above that previously found, the corresponding density referred to air as unity being 1·5297, or to oxygen as 16 : 22·143. The excess above 22 is attributed to deviation of the gas from Boyle's law between atmospheric pressure and a condition of great rarefaction. W. H. St.

3161. *Relations between the Crystalline and Amorphous States as disclosed by the Surface Flow of Solids.* **G. T. Beilby.** (Chem. News, 90. pp. 141–142, Sept. 16, 1904. Paper read before the British Association, at Cambridge.)—The bearings of the author's theory [see Abstract No. 1875 (1904)] on various questions are discussed. The polishing of a lens of rock-crystal is due to the production of a flowed surface-layer of amorphous material. The amorphous state passes back into the crystalline state at a definite temperature, the "stability-point." In the case of ice at the low temperatures of the Arctic Circle the amorphous form may be stable. The grinding of crystalline substances into powder involves the conversion of a portion into the amorphous state, and it is this which acts as the cementing material when crystalline powders are compressed into cakes. The bearing of the author's views on the flow of rocks is also considered. F. G. D.

3162. *Waves in Deep Water.* **Kelvin.** (Roy. Soc. Edinburgh, Proc. 25. pp. 311–327, 1903–1904. Phil. Mag. 8. pp. 454–470, Oct., 1904.)—This continues the mathematical discussion of the front and rear of a free procession of waves. [See Abstract No. 1883 (1904).] J. W. P.

3163. *Formation of Sand-Ripples.* **J. Joly.** (Roy. Dublin Soc., Proc. 10. 27. pp. 328–330, Sept. 23, 1904.)—The author observed on the Kerry coast that sand grains were carried by the wind over the crest of one ripple, described a trajectory through the air and impinged on the next slope below the crest, over which they were again transported. Heavier grains were rolled over the crests. The wave-length and height of the ripples should, therefore, be interdependent. On inclines facing the wind the wave-length is indeed shortened, and on inclines away from the wind lengthened beyond the normal. An artificial ripple, three times the normal height, had its crest blown away, and an elevation was formed several wave-lengths from it, the hollow between them becoming deepened. The dimensions of the ripples depend upon the wind force and upon the density and coarseness of the sand. Any wind velocity above a certain limit will raise ripples whose dimensions will approximate to a certain average; and this will hold also for moving water, which, owing to its greater transporting power, will have a lower limiting velocity. H. B.

3164. *Temperature Decrease in the Atmosphere up to Heights of* 10 *km.* **J. Hann.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 571–605, May, 1904.)—An analysis of the data collected during 156 balloon ascents from Paris, Strassburg, Berlin, Vienna, and of Teisserenc de Bort's 581 balloon observations. For the first km. the time of the day has too great an influence to allow of general conclusions. The observations of the early balloon ascents from Berlin are confirmed. Between km. 1 and 3 the maximum decrease of temperature takes place in May and June, between km. 3 and 7 in February and March, in the highest layers in summer. The agreement between the temperature changes in the free atmosphere and on high mountains is surprisingly good, and references to the Sonnblick, Graz, and Jakutsk show that the annual temperature curve may be derived from the seasonal means. The mean annual temperatures are—

At km. 1	2	3	4	5	6	7	8	9	10
+ 6	1·7	− 3·3	− 9·0	− 15·3	− 22	− 29	− 36·2	− 43·2	− 49° C.

and the temperature decreases per 100 m. are : (*a*) Balloon ascents ; (*b*) Bort's *ballons sondes* :—

(*a*)	0·52	0·47	0·59	0·62	0·65	0·72	0·68	0·62	(0·85°C.)
(*b*)	0·46	0·47	0·54	0·60	0·65	0·71	0·72	0·73	(0·58°C.)

H. B.

3165. *Stellar Parallax Determinations at Yerkes.* **F. Schlesinger.** (Astrophys. Journ. 20. pp. 123–130, Sept., 1904.)—The excellent definition obtained with the 40-in. Yerkes telescope when the photographs are taken on isochromatic plates with an interposed yellow screen led to an attempt being made to utilise them for determination of stellar parallax. It was found, however, that the introduction of the screen film might cause some uncertain distortions, and experiments with certain brands of orthochromatic plates resulted in finding that it would be possible to do without the screen, and still obtain the photographs practically by monochromatic light. The plates selected, Cramer orthochromatic, have a very high degree of sensitiveness near λ5600, more so indeed than to the blue about λ4500, so that for a point source light of the wave-length 5600 will alone be effective, the light of greater and less refrangibility being much weaker. This is further accentuated by the particular colour curve of the 40-in. refractor, which becomes very steep near λλ4400–4500, so that the star disc due to this colour will be much out of focus, and therefore scarcely effective in producing an image of the star on the photographic plate. Examples of photographs obtained in this way are given, and the probable errors per exposure computed. The results are very promising as affording reliable data for work on stellar parallax. C. P. B.

REFERENCES.

3166. *Apparatus for the Study of Condensation Nuclei.* **H. Rebenstorff.** (Phys. Zeitschr. 5. pp. 571–574, Sept. 15, 1904.)—Into the vessel in which the condensation is to take place there protrudes a rubber or collodion balloon. The sudden expansion of the air required for fog production is brought about by allowing this balloon to collapse. It may be covered with a layer of water if necessary.

R. S. W.

3167. *Wave Apparatus.* **W. Schmidt.** (Deutsch. Phys. Gesell., Verh. 6. 19. pp. 249–254, Oct. 15, 1904. Phys. Zeitschr. 5. pp. 683–685, Oct. 20, 1904.)—This consists of a set of twenty-one steel spiral springs fixed vertically, and with a metal ball at the mid-point of each. Displacements are given to the ends of the springs by wooden frames having the forms of the waves to be superposed. The balls indicate the resultant wave-form. The apparatus is used for stationary and for interference waves. J. W. P.

3168. *Time-measurement in Small Falls.* **M. T. Edelmann.** (Phys. Zeitschr. 5. pp. 461–462, Aug. 1, 1904.)—A description of an instrument based on the method of Radaković [see Abstract No. 8 (1901)]. As an example, height of fall = 0·1 cm., resistance = 100,000 ohms, capacity = 0·5 microfarad. Time of fall = 0·01436 sec. The time calculated theoretically is 0·01427 sec. J. W. P.

3169. *Use of Water-gas in Glass-blowing.* **A. Böttcher.** (Zeitschr. Instrumentenk., Beib. 19. pp. 183–186, Oct. 1, 1904. Paper read before the Deutsch. Gesell. f. Mechanik und Optik.)—The author institutes a comparison between oil-gas, coal-gas, and water-gas for glass-blowing purposes, and describes experiments for determining their suitability. Oil- and coal-gas are preferable, but water-gas can be used for the larger articles if it is carburetted as well. L. H. W.

3170. *Torsion of Prismatic Rods.* **L. Prandtl.** (Phys. Zeitschr. 4. pp. 758–759, Oct. 24, 1903. Paper read before the 75 Naturforscherversamml. at Cassel, Sept. 24, 1903.)—A mathematical consideration of the effect on the cross-section. J. W. P.

3171. *Remarks on the Theory of Relaxation.* **L. Natanson.** (Acad. Sci. Cracovie, Bull. 10. pp. 767–787, Dec., 1903.)—A further defence of the author's works [see Abstracts Nos. 694 and 695 (1904)] against the criticisms of Zaremba.

3172. *Speed of Explosion in Homogeneous Mixtures of Air and Coal-Gas.* **H. Mache.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 341–354, Feb., 1904. From the II. physikalisches Institut der k.k. Universität in Wien.)—An explanation is offered of Gouy's result that the consumption of gas by the flame of a homogeneous explosive mixture is proportional to its area, whatever its shape, and the author's experiments confirm this result. Mallard and le Chatelier's experiments are criticised as giving nothing definite. [See also Abstract No. 14 (1904).] R. E. B.

3173. *Theory of the Figure of Celestial Bodies.* **A. Liapounoff.** (Acad. Sci. St. Pétersbourg, Mém. 14. 7. pp. 1–37, 1903, and 15. 10. pp. 1–66, 1904.)—A mathematical consideration.

3174. *Stability of a Vitreous Medium.* **P. Duhem.** (Comptes Rendus, 138. pp. 737–740, March 21, and pp. 844–847, April 5, 1904.)—Papers in which the subject is treated mathematically on the lines indicated in Abstract No. 963 (1904).

3175. *Surface-Tension Theory.* **G. Bakker.** (Ann. d. Physik, 14. 3. pp. 609–619, July, 1904.)—Remarks upon a paper by Hulshof [see Abstract No. 757 (1901)]. The treatment is mathematical. J. W. P.

3176. *New Theorems analogous to Green's.* **P. G. Nutting.** (Phys. Rev. 19. pp. 98–106, Aug., 1904.)—A mathematical investigation of certain theorems on vector functions useful in magnetism, electromagnetism, and optics. J. W. P.

3177. *Observations of Mars at Meudon.* **G. Millochau.** (Comptes Rendus, 137. pp. 636–639, Oct. 27, 1903.)—Several drawings of the planet are given showing the details observed with the great equatorial at Meudon during the spring months of 1901 and 1903. Special attention is drawn to the observations of the fine elongated markings, which, seen as long threads in smaller instruments, are resolved into discontinuous shadings with the large refractor. C. P. B.

3178. *Aggregations of Congruent Bodies.* **H. Minkowski.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 311–355, Sept., 1904.)—An analytical consideration of such aggregates of greatest density. J. W. P.

3179. *Relation between Minima and Maxima of Sun-spots.* **A. Angot.** (Comptes Rendus, 139. pp. 256–257, July 25, 1904.)—Analysis has been made of the spot values for all the available epochs of sun-spot minima and maxima, and it is found that on tabulation of the minima in order of relative spot numbers, the values corresponding to the respective maxima following each minimum are in almost similar relation, all the minima of high-spot values being followed by maxima of high-spot activity, and *vice versâ*. The only exception is in the case of the maximum of 1761, but it is pointed out that as this was near the beginning of the observations, it is possible that the discrepancy is due to changes in the methods of recording the spots. Attention is called to the important fact that the above-described relation is apparently at variance with that connected with the long-period variation of 33 or 35 years, the latter forecasting the approaching maximum to be exceptionally large, like that of 1870, while this new relation implies a maximum of far less activity. [See Abstract No. 717 (1904).] C. P. B.

3180. *Continuous Registration of Solar Phenomena.* **H. Deslandres.** (Comptes Rendus, 139. pp. 337–343, Aug. 1, 1904.)—The author brings together many of his previously expressed views on the necessity for concerted action in the observation of solar phenomena, as he intends to put the matter before the astronomical Congress at St. Louis. [See Abstracts Nos. 292 (1903), and 723 (1904).] C. P. B.

3181. *Perseid Meteors of August,* 1904. **H. Perrotin.** (Comptes Rendus, 139. pp. 457–458, Aug. 29, 1904.)—Observations were made in connection with the Observatory at Nice from August 9–14, 1904, the station being on Mt. Mounier at an altitude of about 2,740 m. The total number of meteors observed on the five nights was 1,184, of which 941 were Perseids and the remainder sporadic. The maximum occurred on the night of August 11 and 12, between 1 a.m. and 3 a.m. It has again been noticed that the shower of meteorites occurred in well-marked pulses, alternating with periods of scarcity of trials. The true Perseids were white, short, and very rapid. The sporadic trails were, on the other hand, yellowish, with less velocities, and described long trajectories. C. P. B.

3182. *Faint Stars in Orion Nebula.* **J. A. Parkhurst.** (Astrophys. Journ. 20. pp. 136–139, Sept., 1904.)—Recent works on new variable stars in this region have not included any near the trapesium of the Orion nebula, the probable reason for this being the comparatively great brightness of the nebulous matter on photographs obtained with short-focus instruments. For this reason a special examination has been made of negatives obtained with the 40-in. Yerkes refractor in 1900 and 1901, limited to a region within 2′ of arc of the trapesium star θ', and only those stars listed which have been seen on several of the plates. A photographic enlargement from the negative of 1900, October 17, is given to illustrate the paper. Several of the stars appear to show decided evidence of variability to the extent of several magnitudes. C. P. B.

3183. *Stars with Variable Radial Velocity.* **V. M. Slipher.** (Astrophys. Journ. 20. pp. 146–148, Sept., 1904. Lowell Observatory Bulletin, No. 11.)—Working with the Lowell spectrograph a further number of stars have been found to indicate variable radial velocities. Particulars are given in the present paper of five of these —α Andromedæ, α Libræ, σ Scorpii, X Sagittarii, and ϵ Capricorni, with the extremes of velocity determined for each. C. P. B.

LIGHT.

3184. *Determining the Dip of the Horizon on Ships.* **C. Pulfrich.** (Zeitschr. Instrumentenk. 24. pp. 225–229, Aug., 1904. Communication from the Optical Workshops of C. Zeiss.)—If two mirrors be joined under 90°, and their edge placed horizontally, the observer looking downward or upward will see the two apparent horizons, on his right and left, separated by a distance corresponding to the double dip of the horizon. In the instrument the mirrors are replaced by totally reflecting prisms—or by a pentagonal prism—connected with an astronomical telescope ; the horizon in front is also seen. In another form, the angle is more conveniently measured with the aid of a micrometer screw, by turning one of the mirrors about the edge until coincidence is obtained. The doubtful point is that the dip of the horizon need not be the same on both sides. The instrument is also recommended for bringing a ship exactly between two points, for determining the vertical oscillations of the vessel, and for ascertaining the distance of another vessel or of a coast. H. B.

3185. *Absorption of Light by Aqueous Solutions of Copper and Nickel Salts.* **E. Müller.** (Ann. d. Physik, 12. 4. pp. 767–786, Oct., 1903. Extract from the Berlin Inaugural Dissertation.)—The light from a Nernst lamp was reflected from two mirrors, and the two beams, after passing through the solutions of the metallic salts, were photometrically compared by means of a Lummer and Brodhun apparatus. The following results were obtained: In the case of $CuSO_4$, $CuCl_2$, and $CuBr_2$, the copper atom exerted the same absorption in both weak and strong solutions. No absorption was observed beyond that due to the copper in strong solutions of $CuSO_4$, but increased absorption was noticed in the case of $CuCl_2$ and $CuBr_2$, this being no doubt due to the Cl_2 and Br_2. As the dilution was increased the molecular extinction coefficient tended towards a maximum value ; after this value was reached further dilution had no influence upon the molecular absorption. This maximum value was the same for all copper salts, a fact which is in agreement with the Knoblauch-Ostwald theory. Similar facts were observed in the case of the nickel salts. It was also noticed that a rise of temperature produced the same effect as an increase in concentration, and *vice versâ.*

E. C. C. B.

3186. *Particular Case of Accidental Double Refraction in Liquids which may lead to the Determination of their Time of Relaxation.* **L. Natanson.** (Acad. Sci. Cracovie, Bull. 1. pp. 1–22, Jan., 1904. Journ. de Physique, 3. pp. 606–611, Aug., 1904.).—In an experiment made by Kundt, the subject of this paper, there are two coaxal and concentric right cylinders, and the space between them is filled with liquid. It is set in rotation round the axis, and a beam of light parallel to the axis is transmitted. For certain liquids it is observed that the greatest obscurity is situated on a line, making the angle $\pi/4$ with the planes of vibration of the polariser and analyser respectively. For certain other liquids, for instance collodion, the greatest obscurity is nearer to the plane of vibration of the polariser, or more distant from that plane, according as the rotation of the cylinder is in direction opposite to, or with, the hands of a watch as seen by an observer looking along the axis of the cylinder in the direction opposite to that of the incident light. The object is to deduce these results theoretically from the theory of viscous liquids. The medium being referred to axes Ax, Ay, Az fixed in space, of which Az is parallel to the axis of the cylinder, and to moving axes Aξ, Aη, Aζ, of which Aζ coincides with Az, the components of deformation at a point x, y, z (which are parallel to the plane of x, y) referred to the fixed axes are ε_x, ε_y, γ_{xy}, and referred to the moving axes, ε_ξ, ε_η, $\gamma_{\xi\eta}$, and if ϕ be the angle between A$_x$ and A$_\xi$ at time t, it is found from geometric considerations that—

$$\varepsilon_\xi = \varepsilon_x \cos^2\phi + \varepsilon_y \sin^2\phi + \gamma_{xy} \sin\phi \cos\phi,$$
$$\varepsilon_\eta = \varepsilon_x \sin^2\phi + \varepsilon_y \cos^2\phi - \gamma_{xy} \sin\phi \cos\phi.$$

Each particle of the liquid in rotation describes a circle round the axis of the cylinder, *i.e.*, of z, and its velocity depends only on its distance, r, from that axis. It is assumed further, using results obtained by the writer in 1901, that the phenomena of accidental double refraction in liquids should be attributed to what he calls the real (véritable) deformation. It is now evident, says the author, that the points of greatest obscurity are those points for which the principal axes of the deformation in the plane of x, y are parallel to the planes of vibration of the polariser and the analyser respectively. And on this assumption he finds that this position (which makes the angle χ with the plane of vibration of the analyser) is given by—

$$\cot. 2\chi = \mp \frac{\varepsilon_r - \varepsilon_q}{\gamma_{rq}},$$

the upper or lower sign being taken according as the rotation as seen by an observer looking along the axis of the cylinder in the direction of the light is opposite to or the same as that of the hands of a watch. Here q is the velocity of the particle perpendicular to the radius, and ε_r and ε_q are the deformations ε_ξ and ε_η when the ξ axis coincides with the radius, and γ_{rq} has corresponding meaning. This result agrees with Kundt's observation. It is now further assumed that the deformation of an element Ω of the liquid as it passes from a point A to a neighbouring point A′ in the time dt, consists (1) of a translation AA′, (2) a pure deformation, and (3) an elementary rotation round an axis parallel to Az, expressed by $\frac{1}{2}\left(\frac{dv}{dx} - \frac{du}{dy}\right)dt$, u and v being the x and y velocities of a particle of liquid in the element. The deformations of the element referred to axes A$_j$ coinciding with AM, M being the position of the element, and A$_k$ at right angles to it in the plane of $x\,y$, are ε_j and ε_k, and introducing the "law of relaxation" the writer obtains $\frac{d\varepsilon_j}{dt} = \varepsilon_j - \frac{\varepsilon_j - \frac{1}{3}\Theta}{T}$, $\frac{d\varepsilon_k}{dt} = \varepsilon_k - \frac{\varepsilon_k - \frac{1}{3}\Theta}{T}$, $\frac{d\gamma_{jk}}{dt} = c_{jk} - \frac{\gamma_{jk}}{T}$. Here c is a geometrical quantity explained by reference to equations 12, 14. Also $\Theta = \frac{1}{2}(\varepsilon_j + \varepsilon_k) = \frac{1}{2}(\varepsilon_r + \varepsilon_q)$, and T is the time of relaxation. Hence is found $\cot 2\chi = \pm T\left(\frac{dq}{dr} - \frac{q}{r}\right)$. The equation to the locus of greatest obscurity is investigated. It agrees with Kundt's observations, and shows their relation to the time of relaxation T. The results are compared with those obtained by Zaremba (Acad. Sci. Cracovie, Bull. p. 611, 1908). The assumption on which the writer's investigation of 1901, above referred to, is founded is that Hook's law holds for liquids, if applied, not to the apparent, but to the real (*véritable*) deformations. Finally the writer shows that Kundt's observations cannot be explained by the classic theory of viscosity, which would lead to the result $cot\,\chi = 1$ in all cases. S. H. B.

3187. *Optical Notes.* **W. W. Coblentz.** (Phys. Rev. 19. pp. 89–97, Aug., 1904.)—The spectrum colours which are seen at an angle of almost grazing incidence on films of certain liquids placed between two plates of rock salt are due to the nearly equal values of the refractive indices of the two media, the dispersion curve for rock salt crossing those of the liquids examined, viz., benzaldehyde, eugenol, safrol, methyl eugenol, and cuminol, at a small angle. The second part of the paper records observations of the infra-red absorption spectrum of selenium, pure and commercial, and of sulphur to $\lambda = 14\mu$. G. E. A.

3188. *Irradiation in Photography.* **H. Farmer and G. Symmons.** (Photographic Journ. 44. pp. 239–244; Discussion pp. 245–248, Aug., 1904.)—In direct screen colour work, it was found that, in employing orthochromatic collodion emulsions, the screen negatives became veiled and clogged between the dots in approaching the high lights, a great loss of gradation simultaneously occurring. These effects are put down to "irradiation," the effect of which is illustrated by photographs of glow-lamp filaments and lines of various thicknesses. The points emphasised in the paper are (i.) the occurrence of irradiation in all negative-making processes; (ii.) that the extent of the irradiation varies with the character of the film and with the exposure; (iii.) the exposure which gives irradiation in a marked degree may be the same as, or much longer than that which produces the ordinary photograph; and (iv.) that when isolated from halation and vignetting action, the thickened lines or dots due to irradiation have sharp edges. The employment of this effect gives a control of gradation which removes the difficulties that have beset the colour operator who employs collodion emulsion for direct work. G. E. A.

3189. *The Silver Grain in Photographic Plates.* **R. J. Wallace.** (Astrophys. Journ. 20. pp. 113–122, Sept., 1904.) The photographic plate best suited to the needs of the astronomer and physicist combines the highest speed with the fineness of grain necessary for enlarging purposes. A number of high-speed plates of different makes (American) are chosen, and the one found to conform to the above requirements is the Seed "27 Gilt-edge," this make having the finest grain-particles of most definite uniformity, and the least tendency to "chemical fog." After similar sensitometer exposures and developments, the silver grain of the plates is brought out by means of a series of photo-micrographs showing the individual particles of reduced silver. Intensification with mercuric chloride has the effect of enlarging the single grains from about 2·5 to 5·0 μ, and the group particles from 4·0 to 10·5 μ. In testing the influence of speed of development, one hour's development with rodinal produced grains varying from 8·0 to 8·7 μ; whereas with a 70-sec. development in a mixed developer containing hydroquinone, metol, and adurol, the grains ranged from 1·4 to 1·8 μ in size. G. E. A.

3190. *Direct Photography in Natural Colours on Paper.* (Scientific American, 91. p. 158, Sept. 3, 1904.) The following details are given by an anonymous writer in Photographische Chronik. Writing paper free from wood can be made sensitive to different colours by being soaked in a bath which consists of a mixture of alcoholic solutions of primrose, Victoria blue, cyanin, curcumin, auramin, and an addition of anethol. The bath is tested by exposing a sensitised strip of paper under a test negative composed of red, yellow, green, and blue strips of glass. The bath is kept at 20° C., and the sensitised paper is dried at the same temperature. Since its light-sensitiveness diminishes rapidly, the paper has to be exposed at once, and under favourable conditions good results have been obtained with five minutes' exposure. The exposure is made under a coloured glass, transparency or lantern slide. By modifying the bath, pictures of artificial flowers can be directly obtained in the camera. The colours, however, are somewhat weak. The print is washed in benzol for an hour, so as to remove the last trace of anethol, and dried at 30° C. It is next left for two or three hours in a saturated solution of copper sulphate, then washed, dried, and mounted. The pictures are not permanent, since they bleach in direct sunlight; but with only occasional exposure in diffused light, they remain unchanged for years. In a modification of the process, an ordinary platinum print is made, which is then sensitised and exposed under a coloured negative. The light-sensitiveness of the paper depends essentially on the nature of the fibres of which the paper is made.

G. E. A.

3191. *On the Theory of the Zeeman Effect.* **A. A. Robb.** (Ann. d. Physik, 15. 1. pp. 107–145, Sept., 1904. From Göttinger Dissertation.)—Experimental results on the Zeeman effect have been by no means always in agreement with each other, Michelson's results obtained by the interferometer, for instance, having been questioned by other observers. Hence, the writer of this paper seeks to establish a theory *à priori* which may explain the phenomena. His theory, he says, deviates in some measure from that of Lorenz, but agrees with that of Voigt in the introduction of additional degrees of freedom of the vibrating molecule, the vibrations in which, while not themselves giving rise to radiation, influence those to which the radiation is due. Lorenz, he says, assumes the oscillations of a single electron about a centre to which it is attracted with a force varying as the distance. In more complex cases experiment shows that we have many spectral lines, for the most part clearly defined. This implies a certain symmetry in vibrations as regards direction—and in the theory by which the author seeks to explain the phenomena, the electrons have relations sufficiently symmetrical to account for the clearness of the lines, whether the system is in a magnetic field or not. He proposes to consider generally a system of electrons having n degrees of freedom, and the electrons are subject, in addition to the central force, to other forces at right angles thereto. In order that the oscillations about the centre may be harmonic, he finds it necessary that the same relation must hold between the velocities as between the co-ordinates. One example is given of a particle moving on the cone $x^2+y^2-z^2=0$. Quoting Routh (Rigid Dynamics, vol. 2, chap. 2) he finds that if the motion be on a generating line we may have the condition $\left(\frac{dx}{dt}\right)^2+\left(\frac{dy}{dt}\right)^2-\left(\frac{dz}{dt}\right)^2=0$. The relation between the co-ordinates of the system of electrons is called *the principal relation.* The relations between these differential coefficients are the *associated relations.* On these principles he discusses first the case of two electrons between the co-ordinates of which subsists a principal relation $f=0$, and in the absence of a magnetic field. Inasmuch as the distances of the electrons from the centre are not altered by rotation, the functions $x_1^2 + y_1^2 + z_1^2$, $x_2^2 + y_2^2 + z_2^2$, and $x_1x_2 + y_1y_2 + z_1z_2$, remain constant, and therefore f must have the form $f = a(x_1^2 + y_1^2 + z_1^2) + 2b(x_1x_2 + y_1y_2 + z_1z_2) + c(x_2^2 + y_2^2 + z_2^2) = 0$, and if there is to be a single spectral line due to their vibrations, $a = c$, whence $f = a(x_1^2 + y_1^2 + z_1^2 + x_2^2 + y_2^2 + z_2^2) + 2b(x_1x_2 + y_1y_2 + z_1z_2)$, and the associated conditions first and second are found by writing x_1', and x_1'' for x_1, &c. The equations of motion, subject to this principal condition, will have for each co-ordinate the form $x'' + A^2x = \lambda df/dx = \lambda(ax_1 + bx_2)$, λ being the indeterminate multiplier, and it is shown that if the associated conditions are fulfilled, $\lambda = 0$. If there be a magnetic field, the last relation is replaced by $\lambda =$ constant. He then obtains a solution of the equations of motion of the two electrons in the magnetic field. Subsequently he treats the cases of three and four electrons respectively. He then gives a theory of a spectrum line which, if in a magnetic field, has nine components, and discusses the same line in the case of no magnetic field. Finally the results of the theory are compared with observations. S. H. B.

3192. *Spectrum of Emanium.* **J. Hartmann.** (Phys. Zeitschr. 5. pp. 570–571, Sept. 15, 1904. Astrophys. Observatorium, Potsdam, Aug. 4, 1904.)—Giesel observed that this spectrum consists of three lines—one in the blue, one in the green, and one in the yellow regions. The wave-length of the first line, as determined photographically, is 4885·4 ± 0·1 ; the intensity of the other two lines is too small to admit of anything but an inaccurate visual measurement, which gave as their wave-lengths 5300 ± 6 and 5909 ± 10. These lines are thus quite new, and, it is especially interesting to notice, do not agree with those observed by Ramsay in the spectrum of the radium emanation [see Abstract No. 2165 (1904)]. The author thinks it possible that the lines may be found in the spectrum of new stars. The line at 4885 is very broad, having a width of 19·7 units. E. C. C. B.

3193. *Oxygen Absorption Bands of the Solar Spectrum.* **O. C. Lester.** (Astrophys. Journ. 20. pp. 81–104, Sept., 1904. Amer. Journ. Sci. 18. pp. 147–156, Aug., 1904. Condensed.)—The great oxygen absorption bands have been remeasured with as great an accuracy as possible with a concave grating of 21·5-ft. focus and 20,000 lines to the inch. Some new lines in the bands A, B, and a extending the series have been discovered ; the band a' has been studied in the relation to the other groups, and also a new band a'' has been measured beginning at $\lambda = 5377·2$. On comparing the wave-lengths measured with those calculated from Deslandres' formula $N = a + bn^2$, it was found that the differences between observed and calculated increased with n. It was evident that Deslandres' formula does not express the results, and that b is not a constant but changes with n. Using this formula the values of b were calculated for the different values of n, and on plotting these it was found that the bn-curve was very nearly a rectangular hyperbola. From this we have $bn = k =$ constant, but as k is still subject to variation we may correct as follows : $bn - (n/c) = k$. Substituting in Deslandres' formula we have $N = a + kn + n^2/c$. The author found that this formula expresses his results within the limit of experimental accuracy. E. C. C. B.

3194. *Methyl Fluoride.* **J. N. Collie.** (Chem. Soc., Journ. 85. and 86. pp. 1317–1318, Sept., 1904.)—This gas, prepared by the action of heat upon tetramethylammonium fluoride, was freed from trimethylamine by treating with sulphuric acid, and was purified by fractionation in liquid air. The boiling-point was found to be -78° at 742·5 mm. pressure. On filling a vacuum tube with the gas at 2 mm. pressure the spectrum showed at first a band at 5200 and lines at 5160, 5055, and 5040. This spectrum, however, rapidly gives place to that of hydrogen ; if now a jar and spark-gap is intercalated, four pairs of lines appear at 6374 and 6355, 5988 and 5960, 5060 and 5046, and 4566 and 4555. These lines are due to silicon owing to the fact that the following reaction has taken place, $4CH_3F = 4C + 4H_2 + 2H_2F_2$; the H_2F_2 acts upon the glass producing SiF_4, which, as is well known, gives the silicon lines when exposed under reduced pressure to the condensed spark.

E. C. C. B.

3195. *Formation of Helium from the Radium Emanation.* **F. Himstedt** and **G. Meyer.** (Ann. d. Physik, 15. 1. pp. 184–192, Sept. 27, 1904.)—Fifty mgm. of radium bromide were placed in a U-tube to which a vacuum tube was sealed. The vacuum tube was provided with a capillary at the bottom of each limb and a pair of aluminium electrodes at the top. The apparatus was exhausted, and hydrogen (dried by cooling in liquid air) was led, during 72 hours, over the radium salt and through the vacuum tube, the latter being cooled with liquid air. The vacuum tube, whilst still cooled, was exhausted and sealed, and glowed brilliantly. It gave only the spectrum of hydrogen and carbon monoxide, even after keeping for 8 weeks and sparking during 39 hours ; a negative result was also obtained at the end of 3 months. After 4 months, however, the red, yellow, green, and blue lines of the helium spectrum were clearly visible. Their slow appearance is perhaps due to the presence in the tube of a larger proportion of hydrogen than in the experiments of Ramsay and Soddy ; the helium would then only become visible when the hydrogen had been driven into the glass and into the electrodes by long sparking. Experiments were also made with radium sulphate, which was heated to a bright-red heat in an exhausted quartz tube. The quartz tube had been sealed to a micro-vacuum tube without electrodes, and this was illuminated by means of Tesla rays. For 3 days no helium lines were visible in the spectrum, but at the end of 3 weeks the red, yellow, green, and blue lines were seen, and increased in brightness during the following fortnight. The intensity of the lines was slightly increased by heating the radium salt, but much greater clearness was obtained when the quartz tube was cooled in liquid air, by which means the continuous spectrum was much reduced ; when the tube became warm again the lines abruptly became less distinct, as if some substance which had gradually condensed in the cold tube had suddenly vaporised. The band spectrum of this substance could not be measured, and it was not possible to decide whether it might be the emanation or merely carbon monoxide. The authors conclude that unless the radium holds the helium with such tenacity as to withstand the effect of prolonged heating in a vacuum, "a fresh quantity of helium had actually been produced from the radium preparation." T. M. L.

3196. *Intensification of Chemical Action by the Emanation from Gold and Platinum.* **G. T. Beilby.** (Chem. News, 88. pp. 178–179, Oct. 9, 1903. Abstract of paper read before the British Association, at Southport.)—When a piece of gold or platinum foil is heated on a glass slip in an atmosphere containing the products of combustion of coal-gas, a halo, chiefly made up of the products of decomposition of the glass, is formed on the glass surface surrounding the foil. If the halo is breathed on, the slight condensation of moisture on the surface dissolves the soluble salts, and sets free silica or an insoluble silicate in the form of thin films and spicules. When the water has evaporated a crystalline deposit is left on the surface. By prolonged heating the whole of the exposed surface of the glass slip is slightly attacked, but the intensity of this attack is not to be compared with that which occurs near the metal. The chemical action to which the halo is due is therefore directly influenced by the presence of the hot metal. A fairly free circulation of the atmosphere surrounding the metal is necessary if well-marked halos are to be produced. It was also found that the partial exclusion of the products of combustion from the air-bath adversely affected the formation of halos. The decomposition of glass in the neighbourhood of hot metals appears to be a case of accelerated or intensified chemical action induced by the energy of the particles shot out from the hot metal. It is therefore possible that some of the cases of catalytic action by platinum and other substances may be accounted for by the existence of active emanations surrounding the catalyte, and not merely by the actual contact of the molecules of the re-agents with its surface. T. M. L.

3197. *Diffusion of Radium-Emanation in Liquids.* **F. Wallstabe.** (Phys. Zeitschr. 4. pp. 721–722, Oct. 15, 1903. Extract from the Hallenser Dissertation.)—Let the radiation intensity of the active body at time t be written, $J_t = J_0 e^{-at}$, J_0 being the value at the beginning of the experiment. Then by the present research the value of a for water was 0·17 per day, which is in agreement with the values found by Curie and Rutherford for air. The value of a for toluol was found to be 0·21 per day. The diffusion coefficients for water and toluol were respectively determined to be 0·066 cm.²/day and 0·373 cm.²/day. E. H. B.

3198. *Further Researches on the Luminous Phenomenon produced by Ozone and by Radium.* **F. Richarz** and **R. Schenck.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 13. pp. 490–493, March 3, 1904.)—A part, but by no means the whole, of the luminous effect produced by the action of radium salts on Sidot's hexagonal blende, is eliminated by replacing the air by carbon dioxide, and appears to be due directly or indirectly to ozone. This effect is probably caused by oxidation of the sulphide to sulphate, and is therefore similar to the luminosity of yellow phosphorus. Red phosphorus does not usually produce any luminous effects, but becomes luminous in presence of ozone; this effect is especially pronounced in the case of phosphorus separated from phosphorus tribromide, and is analogous to the luminous effects in the case of the blende. Glacial arsenious acid glows faintly in ozone, and turpentine vigorously; similar effects were produced when a finger was exposed to ozone, and also in the case of wool, paper, linen, and cotton wool. [See also Abstract No. 296 (1904).] T. M. L.

3199. *Action of Radium Rays on the Halides of the Alkali Metals and Analogous Heat Effects.* **W. Ackroyd.** (Chem. Soc., Journ. 85. and 86. pp. 812–817, June, 1904.)—The colour changes produced by radium rays in chlorides of the alkali metals divide these elements into two sub-groups: (1) LiCl (no colour), NaCl (yellow); (2) KCl (violet), RbCl (blue), CsCl (green); the division into these two sub-groups is also indicated by the coefficient 1/molecular volume. The colours produced are relatively stable while they remain in darkness. In daylight their rate of disappearance varies with the intensity of the light. The sensibility to the action of the radium rays increases with the molecular weight. When the induced phosphorescence has decayed so as to be no longer visible it can be revived by infra-red radiation or by gentle warming (to 37°). The effect of radium compounds in producing phosphorescence and change of colour was dealt with by the author in a paper read before the British Assoc., at Southport (Chem. News, 88. pp. 205–206, Oct. 23, 1903.) T. M. L.

3200. *Effect of Röntgen Rays on Fluor-spar.* **W. Radebolt.** (Beibl. Ann. d. Physik, 28. 17. p. 941, 1904. Extract from Dissertation, Rostock, 1903.) —The author confirms the results of Winkelmann and Straubel [see Physical Soc., Abstract No. 825 (1896)] as far as the strengthening of the photographic effect, resulting from a transformation of the rays by the spar, is concerned ; but shows that the rays so transformed are not ultra-violet rays as Winkelmann and Straubel considered, but only those of the visible spectrum. Different specimens of the spar showed differences in their effects, and only the most effective varieties were made use of. It was observed also that the edges of the crystals were photographically inactive ; this effect is independent of the Röntgen rays, and is probably due to total reflection in the interior of the crystal. No secondary Röntgen or kathode rays were observed. L. H. W.

3201. *Decay of Excited Activity from Thorium, Radium, and Actinium.* **Miss H. Brooks.** (Phil. Mag. 8. pp. 373–384, Sept., 1904.)—If a plate is exposed to the emanation from thorium for a short time only, it has been shown by Rutherford that the radiation thus excited increases at first after removal, reaches a maximum in a few hours, and then decays at the same rate as for a long exposure [see Abstract No. 1193 (1903)]. This can be explained by supposing two changes to take place in the matter deposited on the plate ; the first produces no rays, the second produces rays capable of ionising the gas. Both follow a law expressed by $N_t = N_o{}^{-\lambda t}$, and the constant λ is determined for each of the changes. It is found that half the matter from thorium undergoes the first change in 55 min. ; the second change takes 11 hours to reach half-value. The appearance of radio-activity on the positive electrode after long exposures is found to be due to dust particles. The rate of decay of the excited activity due to radium is measured for α, β, and γ rays separately. Three changes take place here as shown by the decay of the α-radiation ; the first reaches half-value in 3 min. and produces α-rays, the second gives rise to no rays, the third has a period of 28 min. and gives rise to α-rays. Only the last of the changes gives rise to β-rays, and these are accompanied by γ-rays. In the case of actinium there is a rayless change, half the matter being transformed in $1\frac{1}{2}$ min. R. S. W.

3202. *Plan of a Combination of Atoms to have the Properties of Polonium or Radium.* **Kelvin.** (Phil. Mag. 8. pp. 528–534, Oct., 1904.)—The properties to be explained are : (1) To store a large, finite amount of energy in a combination having very narrow stability. (2) To expend this energy in shooting off with very great velocity, vitreously, and resinously electrified particles. In the title polonium means a substance which shoots off vitreously electrified particles abundantly and with very great velocities, but few or no resinously electrified particles. Radium means a substance that shoots off in extraordinary abundance both vitreously and resinously electrified particles. From the kinetic theory of gases, it seems certain that every kind of matter has some radio-activity ; that is to say, shoots off both vitreously and resinously electrified particles. Hence it is only in their extraordinarily great abundance and great velocities of shooting that polonium and radium differ from ordinary matter. The term electrion is used in the paper to signify an atom of resinous electricity. A plan given for molecular structure of polonium may be described as two void atoms held together against their mutual repulsion by a bond consisting of one electrion. A plan of molecular structure given for the emission of the β-rays of radium may be described as two electrions held together against their mutual repulsion by a bond consisting of one void atom. Certain relative charges of vitreous electricity are now assigned to the void atoms, and the attractions and repulsions dealt with. It is then shown that a slight displacement from the initial state may bring about an explosion of the atoms. [See also Abstracts Nos. 861 (1902) and 624 (1903).] E. H. B.

3203. *Colourations produced by Becquerel Rays; Colorimetric Determination of Radio-activity.* **C.-J. Salomonsen** and **G. Dreyer.** (Comptes Rendus, 139. pp. 533–535, Oct. 3, 1904.)—The authors have examined various crystals with a view to the use of the change of colour produced in these by radio-active substances, for a scale of radio-activity; but the results were unsatisfactory. With glass, however, and particularly with the boro-silicate crown glass No. 3453 of Schott, fairly satisfactory effects were obtained. The small glass plate was exposed over pure radium bromide contained in an ebonite capsule with mica window, in front of which was an ebonite plate with a square opening (16 sq. mm.). No colouration was produced in 20 min., but in 24 min. there was a distinct colouration when the glass was held against a white background. Other parts of the plate exposed for from 30 min. to 8 hours show an increasing depth of colouration. Investigations are being made as to the possibility of using this property for obtaining an idea of the absolute intensity of the radio-activity. L. H. W.

3204. *Concerning the* N*-rays.* **A. Broca.** (Archives d'Él. Médicale, 12. pp. 723–740, Oct. 10, 1904.)—The author points out that the discussion of the subject of the *n*-rays is a dangerous one at present where so much scepticism exists, but the fact is that the observation of the *n*-rays is an extremely delicate process, and it is only by the aid of an elaborate technique that one is able to convince oneself on the subject; in the author's case it was six weeks before he could see the effects of the rays. He then gives a brief history of the rays and the means of observing them, together with a number of hints as to the more desirable methods and certain precautions necessary. Thus the phosphorescent screen should not be used for the first minute after insolation, nor longer than 5 min. after; it is best to expose it afresh every 5 min., and to use either the electric arc, the Auer burner (without glass) or magnesium light. The comparison of the luminosity of the screen when placed first shielded from the rays and then exposed to them is considered far more reliable than the usual successive exposures. The physiological condition of the observer is also of importance. The retina must be placed under suitable conditions and be adapted to darkness, or at least very feeble light. The movement of the screen must be entrusted to another person, and the observer left with his mind free; the movement should also only be made at the command of the observer, a condition of surprise being unsuitable for the proper observance of the effects. The effects due to heat should always be borne in mind when examining the action on phosphorescence: the physiological radiations especially can be entirely swamped by the heat effects. The two effects can be distinguished by the slight lagging (up to a few seconds) behind of the effect when due to the *n*-rays, such lag being much greater in the case of the heat effect; and on the cessation of the action the difference in the lag is even greater. The *n*-ray effect may also be distinguished by the different behaviour when viewed normally, at 45°, and at a grazing incidence. The remainder of the paper deals with the methods of production, physical properties, and mechanism of action of the rays, all of which have already been dealt with from the original communications. L. H. W.

3205. *Induced Radio-activity.* **K. A. Hofmann, L. Gonder,** and **V. Wölfl.** (Ann. d. Physik, 15. 3. pp. 615–632, Nov., 1904. Communication from the Chem. Laborat der kgl. Akad. d. Wissenschaften zu München.) —It has previously been shown that besides the ordinary method of activation, metals can be made active by mixing them with the primary radioactive material (radium salt) in solution and afterwards separating them by a precipitant. The activation so produced is much greater initially and lasts so very much longer than the ordinary activity, that one is inclined to doubt whether it is produced by the same emanation. The experiments described were made for the purpose of seeing if first other non-transient products resulted from radium, which later change over into the emanation. No definite conclusion can be arrived at from the results, but these latter possess considerable interest. The activation was effected by uranium, radium, radio-active lead, and radio-active bismuth. The experiments are dealt with at length in the original paper, the following being the authors' summary of the chief points. Activation so produced (termed ion-activation for shortness) has, besides the properties before mentioned, a selective action, in that the same radio-active substance activates the different elements to a different degree. Uranium and radium on the one hand, and radio-active lead and bismuth (termed radio-lead and radio-bismuth) on the other are differently constituted as regards ion-activation. The α- and β-activity are dissimilarly communicable and disappear at a different rate. Thus, induced bismuth loses its β-activity, in spite of its greater initial intensity, within a few weeks; the α-activity lasts many months. At a high temperature activated platinum metals lose the α-activity in a few seconds; the β-activity remains. A change from α- to β-activity could not be effected by chemical or physical means. In various quantitative chemical transformations both forms suffered only slight weakening, so that activation does not depend on a process analogous to gas occlusion. Both activities can be increased by fractionation. A possible theory of the action is then given. L. H. W.

3206. *Estimation of Excited Radio-activity for Therapeutic Purposes.* **T. Tommasina.** (Comptes Rendus, 139. pp. 728–730, Nov. 7, 1904.)—For estimating the radio-activity acquired by a substance exposed to a radioactive source the author proposes to make use of the Röntgen rays. His experiments show that the excited radio-activity is, as regards intensity and duration, proportional to the state of ionisation of the medium, and the Röntgen rays offer a convenient means of producing such ionisation. The excited radio-activity would in such a case be proportional to the intensity and duration of the Röntgen-ray emission. The apparatus used for the purpose is identical with that used by Elster and Geitel (Archives des Sciences, 13. pp. 113–129, Feb., 1902.) It is stated that all kinds of solid bodies, organic and inorganic, have been made radio-active by the method, including fruits, herbs, and living animals. Surgical apparatus and instruments can also be made active; the possible therapeutic value of such an activation is touched upon. L. H. W.

3207. *A Radio-activity Peculiar to Living Beings.* **T. Tommasina.** (Comptes Rendus, 139. pp. 730–731, Nov. 7, 1904.)—In carrying out the experiments dealt with in the preceding Abstract the author noticed that freshly-picked herbs, fruits, flowers, and leaves possessed a feeble radio-activity of their own, though near the limits of sensibility of the electroscope used; dry vegetables showed hardly a trace or none. The traces in the latter case were not of individual radio-activity since they disappeared after four days' isolation at the longest. The method of observation in the case of animals is described, but experiments have so far only been made with birds. These have shown distinct radio-activity, greater in adults than in the young. The phenomenon is held to be general. L. H. W.

REFERENCES.

3208. *Residual Rays of Quartz.* **H. Rubens.** (Phys. Zeitschr. 4. pp. 726–727, Oct. 24, 1903. Paper read before the 75 Naturforscherversamml. at Cassel, Sept. 21, 1903.)—A consideration of the absorption and residual rays for quartz and several other substances. An Auer-burner, a double-walled screen, a silver mirror, a thermo-junction, and the substance whose reflection is to be investigated, constitute the apparatus. For quartz there are two maxima, a double one near 9μ and a simple one at 21μ. J. W. P.

3209. *Colour Equation and Complementary Colours in the Young-Helmholtz System.* **V. Grünberg.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 627–636, May, 1904.)—The author deduces an equation for the relations between the wave-length λ and the complementary wave-length λ_1, viz., $(\lambda - 559)(498 - \lambda_1) = 424$. The λ and λ_1 would therefore lie on one branch of an equilateral hyperbola. The complementary colours to wave-lengths between 494 and 563 (green) would be outside the visible spectrum (Exner's purple). The author makes use of the observations of Helmholtz, Kries, Frey, König, and Dieterici. H. B.

3210. *Photography in Relief.* **C. Baese.** (Photographic Journ. 44. pp. 248–255, Aug., 1904.)—A photograph of an object, which shows the latter in relief, is obtained by means of an ordinary projection lantern with a camera placed alongside. In the lantern, in place of the slide, is a screen graduated as to transparency from end to end. The object to be photographed is placed in front of the lantern within a large conical mirror, by means of which it is illuminated from the sides and from the top so far as the screen allows. Two negatives are made with reversed positions of the screen; from one of the negatives a positive is made and placed on the other negative, and the two give a composite picture from which the relief is printed. G. E. A.

3211. *Optical Resonance.* **F. Pockels.** (Phys. Zeitschr. 5. pp. 460–461, Aug. 1, 1904.)—A reply to F. Ehrenhaft [see Abstract No. 2589 (1904)], correcting the limiting values found by the latter for the diameters of the corpuscles of Pt, Au, and Ag. It is pointed out that an approximate agreement of observation with J. J. Thomson's calculation does not justify any conclusions as to the nature and size of the suspended particles, and the writer re-affirms that the explanation of absorption by resonance cannot stand with a simultaneous employment of Thomson's formulæ for the polarisation of the scattered light. G. E. A.

HEAT.

3212. *Apparatus for Determination of Coefficient of Expansion by Fizeau's Method, at the Temperature of Liquid Air.* **K. Scheel.** (Zeitschr. Instrumentenk. 24. pp. 285–287, Oct., 1904. Communication from the Physikalisch-Technische Reichsanstalt.)—Descriptions of the apparatus and of the method of applying the liquid air are given. The interference apparatus is contained in a cylindrical brass case, surrounded by liquid air. The cooling is produced gradually, so that the interference bands can be counted as they cross the field of vision. The apparatus is filled with carefully dried hydrogen. With air or nitrogen the bands are so unsteady during cooling that they cannot be counted. The temperature is determined by means of a platinum-resistance thermometer. The results of the experiment are not given. S. G. S.

3213. *Thermal Expansion of Dilute Solutions of Certain Hydroxides.* **G. A. Carse.** (Roy. Soc. Edinburgh, Proc. 25. pp. 281–291, 1903–1904.)—The author has investigated the difference in volume between solutions of the hydroxides of sodium, barium, and strontium, and the corresponding quantities of water used in their preparation, incidentally determining the coefficients of thermal expansion of the solutions. With sodium hydroxide, below a certain dilution, the expansion on solution is negative, becoming numerically less with rise of temperature. All the solutions of barium hydroxide examined, *i.e.*, up to 0·89387 gm. per 100 gm. of solution, have negative expansions, the effect of temperature not being very marked. Solutions of strontium hydroxide also exhibit negative expansion, which becomes less numerically with rise of temperature. The coefficient of thermal expansion of sodium hydroxide solutions increases with the concentration, the increase becoming slower as the temperature rises, but with barium and strontium hydroxides, though the results seem to indicate that the rate of variation of expansion coefficient with concentration reaches stationary values in the range considered, no definite conclusion can be drawn owing to the large experimental errors in the expansion coefficients. W. H. Sı.

3214. *Specific Heats of some Sulphides in Relation to their Electrical Conductivity.* **F. Streintz.** (Boltzmann Festschrift, pp. 196–203, 1904.)—The specific heats were determined by the method of mixtures, and gave (for the temperature range 15–100° unless otherwise indicated) the following values: Molten galena, 0·0529; galena, crystals, 0·0557; loose, powdered galena, 0·0601, (15–110°) 0·0686; (15–118°) 0·0673; (15–181°) 0·0699. After-effects were noticeable, in that two experiments following one another gave values for the second several per cent. lower than the first, which crept up after some hours. A pencil prepared from the compressed powder gave irregular results with a mean value of 0·0648, while amorphous lead sulphide gave 0·117; the more highly conducting modification has thus the lower specific heat. In the case of mercury, however, the specific heat of red cinnabar (the non-conductor) is 0·0548, that of the black sulphide (good conductor) 0·1026. Of all the substances examined silver sulphide showed the greatest after-effect, the values increasing also in jumps with increase of temperature, rising from 0·0804 for the range 15–100°, to 0·118 for the range 15–209·5°; the most pronounced jump being between 160° and 170°. L. H. W.

3215. *Formation of Nitric Oxide at High Temperatures.* **W. Nernst.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 261–276, Sept., 1904. From the Göttinger Universitätsinstitut für physikalische Chemie.)—When air is submitted to a high temperature, as in the case of the electric arc, a combination of the nitrogen and oxygen results. The author has now made a systematic examination of the conditions of the reaction. He has used iridium and platinum tubes electrically heated, through which a current of air was passed. A litre of air was passed in t minutes at the absolute temperature T, and the number of c.cm. per litre estimated, as shown in the following table:—

LARGE IRIDIUM FURNACE.

T.	t.	C.cm. NO per Litre.
2033	5·2	4·8
2195	5·6	8·5
2195	9·0	9·8
2195	14·0	7·3

From these figures the heat of combination of NO was calculated. The figure obtained agreed with the thermochemical value. Experiments were also made by passing air over an arc, and also on the formation of NO during the explosion of a mixture of O, H, and N. The results are theoretically examined. W. W. H. G.

3216. *Fluidity and Conductivity of Salt Solutions below* 0°. **W. Hechler.** (Ann. d. Physik, 15. 1. pp. 157–173, Sept., 1904. Abstract of Prize Essay and Inaug. Dissertation, Münster, 1904.)—It has been shown that if the conductivity of a dilute aqueous solution is expressed in the form of a quadratic interpolation formula, extrapolation gives a point of convergence at —39°, whence it is concluded that at this point the internal friction of water should be infinitely great. As dilute solutions cannot be cooled far below 0°, strong solutions of the following were examined: Calcium chloride, sodium chloride, sodium iodide, potassium sulphocyanide, potassium acetate, potassium nitrate with ammonium sulphocyanide, and ammonium nitrate with potassium sulphocyanide. The fluidity was determined by a modification of Poiseuille's method, and the conductivity with the Kohlrausch resistance apparatus. The author gives several tables of results for different temperatures, and then discusses the similarity of the curves showing conductivity and fluidity in relation to the temperature, especially with regard to the points of convergence. F. S.

3217. *Loss of Heat from Incandescent Filaments.* **L. W. Hartmann.** (Phys. Zeitschr. 5. pp. 579–584, Sept. 15, 1904. Phys. Chem. Institut der Univ. Göttingen.)—The loss of heat by radiation from incandescent "black" bodies having been previously fully studied, it was desired to study the losses of heat by conduction and convection in the case of incandescent filaments. The filaments used were made of platinum sponge formed into rods according to Nernst's method, and heated by an electric current. Their temperature was determined by means of a Wanner pyrometer, but it was found that errors arose when the instrument was applied to such narrow filaments. The temperatures were, therefore, finally measured by placing the filaments before the open end of an electric furnace of the Nernst type, and heating both filament and furnace until they appeared of equal brightness; under these conditions temperatures measured by the Wanner pyrometer and by a thermo-couple agreed well. The heat loss by direct radiation is calculated from the Stephan-Boltzmann law, and deducted from the total energy absorbed, which is determined electrically; the difference gives the loss by conduction and convection. An attempt is made to eliminate the latter by enclosing the filament in an evacuated glass bulb, but the absorption of the glass has to be corrected for, and is so large that the values are only regarded as approximate. The results are fully tabulated in the paper; it is found that the conduction and convection losses are relatively much greater with thin filaments, and become insignificant when thicker filaments are used. A formula applicable for filaments of thickness ranging from 0·1 to 1 mm. is given, viz.: $L = 0{\cdot}0010\, lT$ watt, where L is the loss, l the length, and T the absolute temperature. [See also Bottomley, Abstract No. 555 (1903).] W. Ros.

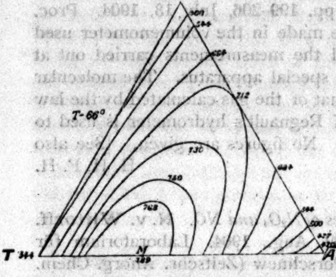
3218. *Change of Dimensions of Matter Owing to Motion in Ether.* **F. Hasenöhrl.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 469–490, March and April, 1904.)—The author calculates that, if the density of radiation-energy within a vacuous enclosure in a state of absolute rest and kept at constant temperature is $\epsilon \equiv 4e/V$, where e is the emissive power of a black body and V the speed of light, the density is $\kappa\epsilon$ in an enclosure moving with speed $v \equiv \sigma V$, where $\kappa \equiv \frac{1}{2}(1-\sigma^2)^{-1} + \frac{1}{4}\sigma^{-1}\log\left\{(1+\sigma)/(1-\sigma)\right\}$, which is approximately equal to $1 + \frac{2}{3}\sigma^2$, when σ is very small. The radiation pressure is then $\frac{1}{3}\kappa\epsilon$. Consideration of a particular reversible cycle on the assumption that the size of a body is independent of its motion, shows a contradiction of the second law of thermodynamics unless some such assumption as that in consequence of its motion the emissive power of a black body is changed to e/κ, which is not likely, is made. If, however, a body's dimension in the direction of its motion is altered by a factor λ in consequence of its speed σV, the cycle seems to show that with Stefan's law $\lambda = \kappa^{-3/4}$ or approximately $1 - \frac{1}{2}\sigma^2$ (Lorentz and FitzGerald's result); but this result entails conditions that make the cycle an impossible one. R. E. B.

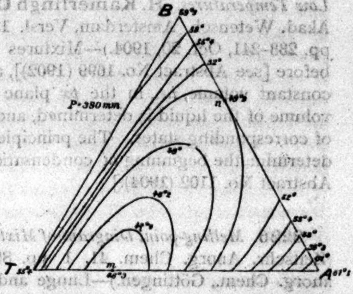
3219. *Reciprocity of Radiation between Bodies in Motion.* **F. Hasenöhrl.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 493–500, March and April, 1904.)—Thermodynamic reasoning shows that, if A and B are points at rest relatively to the æther, a ray from B to A must pass by the same path as one from A to B, only in reversed direction. It is here shown that the same is true when the material system moves relatively to the æther, provided that $(1-k)(1-\sigma^2 k) = \mu^{-2}$, where σ is the ratio of the speed of the system to that of light in free æther, and $k\sigma$ is the alteration-ratio of the speed of light in the system where the refractive index is μ. This gives Fresnel's value $1-\mu^{-2}$ for k as a first approximation, with $-(1-\mu^2)\mu^{-4}\sigma^2$ as the first correction-term depending on σ. R. E. B.

3220. *Irregularity in the Distribution of Gaseous Molecules and its Influence.* **M. v. Smoluchowski.** (Boltzmann Festschrift, pp. 626–641, 1904.)—Though in the theory of gases account is taken of the variations in velocity of the different molecules, the variations of their distribution in space are usually neglected; and, as to the latter, the author calculates that, if there are N molecules in a volume V, the actual number in a volume v will on the average differ from $\nu \equiv Nv/V$ by $\sqrt{(\nu/2\pi)}$. For 1 c.cm. Meyer gives $\nu = 6 \times 10^{19}$, whence $\sqrt{(\nu/2\pi)} = 3 \times 10^{9}$, and the percentage variation increases largely as v diminishes. The bearing of this result on determinations of the entropy, H-function, and characteristic equation of a gas is then discussed, and it is found that van der Waals' expression $a\rho^2$ for the inner pressure should be augmented by a term of the form $\rho/(A + B\rho + C\rho^2 - D\rho/T)$.

R. E. B.

3221. *Vapour Pressure in the System: Benzene, Carbon Tetrachloride, and Ethyl Alcohol.* **F. A. H. Schreinemakers.** (Zeitschr. Phys. Chem. 47. pp. 445–470, March 15, and 48. pp. 257–288, June 7, 1904. Anorgan.-Chem. Laborat. der Univ. Leiden.)—The investigation is very similar to that of water, acetone, and phenol [see Abstract No. 764 (1903)]. In the former case one of the binary combinations (water-phenol) showed a maximum vapour pressure, but the other two (water-acetone: phenol-acetone) neither a maximum nor minimum. In the present instance two of the binary combinations (alcohol-tetrachloride: alcohol-benzene) show a maximum, and the other (benzene-tetrachloride) neither a maximum nor a minimum. The accompanying diagrams show (1) the vapour pressures of different mixtures at 66° C., and (2) the boiling-points under 380 mm. pressure, and well illustrate the general character of the observations (A = alcohol, B = benzene, T = tetrachloride).





T. M. L.

3222. *Phenomena in Binary Mixtures at the Junction of the Plait-point Line and a Solubility Line.* **A. Smits.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 90–102, July 13, 1904. Proc. pp. 177–189, Oct. 20, 1904. Laboratory for Inorg. Chem. Amsterdam.)—The system ether-anthrachinon is investigated at 300° C. with a maximum pressure of about 100 atmospheres. Owing to the great difference in vapour tension, retrograde condensation and liquefaction are more marked than in any previously investigated case. Many diagrams of sections of the surfaces obtained are given in the paper. [See also Abstract No. 1715 (1904).]

H. H. F. H.

3223. *Px Lines with Mixtures of Acetone with Ethylether and with Carbon Tetrachloride.* **G. C. Gerrits.** (Konink. Akad. Wetensch. Amsterdam, Versl.

13. pp. 156–167, July 13, 1904. Proc. pp. 162–173, Oct. 20, 1904.)—A continuation of the work of Cunaeus [see Abstract No. 1888 (1900)] with improvements in method. Values are given for the refractive index corresponding to various combinations of vapour and liquid at various pressures. The values of x_1 and x_2 found are used in deductions with van der Waals' equations for mixtures. A satisfactory coincidence is obtained.
H. H. F. H.

3224. *Heat of Mixture in Associated Liquids.* **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 121–124, July 13, 1904. Proc. pp. 174–177, Oct. 20, 1904.)—From the relations $\frac{\beta^2}{1-\beta} \cdot \frac{1-x}{N} = \frac{K}{2}$ and $W = \beta_0(1-B_0)Qi$, the author deduces for water, using $\beta = 0{\cdot}21$ at 18°, and $Q = 1{,}920$ gm.-cals., $W = 326i$. If the solute is a non-electrolyte $i = 1$, in which case 326 gm.-cals. must be added to the heat given out on the solution of 1 gm. mol.
H. H. F. H.

3225. *Coexistence Conditions of Vapour and Liquid for Mixtures of Gases at Low Temperatures.* **H. Kamerlingh Onnes** and **C. Zakrzewski.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 199–206, July 13, 1904. Proc. pp. 233–241, Oct. 20, 1904.)—Mixtures are made in the volumenometer used before [see Abstract No. 1699 (1902)], and the measurements carried out at constant volume, *i.e.*, in the px plane in special apparatus. The molecular volume of the liquid is determined, and that of the gas calculated by the law of corresponding states. The principle of Regnault's hydrometer is used to determine the beginning of condensation. No figures are given. [See also Abstract No. 1102 (1904).]
H. H. F. H.

3226. *Melting-point Diagram of Mixtures of N_2O_4 and NO.* **N. v. Wittorff.** (Zeitschr. Anorg. Chem. 41. 1. pp. 85–92, Aug., 1904. Laboratorium für anorg. Chem., Göttingen.)—Lunge and Porschnew (Zeitschr. Anorg. Chem. 7, 209, 1894) have shown that the blue liquid obtained by the absorption of NO by liquid N_2O_4 has very nearly the composition corresponding to N_2O_3. This does not prove the existence, however, of a definite compound corresponding to the formula N_2O_3. An accurate phase-study of the question has now definitely proved the existence of a blue crystalline solid possessing the formula N_2O_3. Its melting-point is $-103°$, and at $-112°$ it forms an eutectic mixture with solid N_2O_4. A long-outstanding problem of inorganic chemistry has therefore been at last satisfactorily solved.
F. G. D.

3227. *Critical Volumes by Cailletet's and Mathias' Method.* **M. Centnerszwer.** (Zeitschr. Phys. Chem. 49. pp. 199–207, Aug. 9, 1904. Riga Polytechnikum.)—A number of tubes are filled with various known amounts of substance. The critical temperature is then determined by heating all together, and the author shows that the critical density can be obtained at the same time. Values are given in agreement with former results :—

	Do.	Do.
Methyl chloride	143·0	0·370
Ethylene	194·4	0·258
Methyl alcohol...........................	240·2	0·275

[See also Abstract No. 329 (1904).]
H. H. F. H.

3228. *More Exact Equation of State for Gases.* **J. B. Goebel.** (Zeitschr. Phys. Chem. 49. pp. 129–161, Aug. 9, 1904.)—The author gives a more complete discussion [see Abstract No. 1718 (1904)] of the mathematical and theoretical basis of the equation of state $p = \frac{RT}{v - b_0 + b_1 p} - \frac{a}{(v - \alpha)^2}$, which he has already shown to possess a considerably extensive application to experimental data. The molecular attraction is supposed to vary inversely as the fourth power of the distance, and the author first calculates the value of the internal attractive force for space continuously filled with matter, proceeding from this case to that of discontinuous distributions of molecules arranged according to definite systems of symmetry, the cubical arrangement being taken as a normal type. For the rest the author starts from van der Waals' equation in the form $p = \left\{RT/(v - b)\right\} - K$. His calculation leads to $K = a/(v - \alpha)^2$, where a and α are constants; and as he had previously shown that $b = b_0 - b_1 p$, where b_0 and b_1 are constants, the above equation of state follows. F. G. D.

3229. *Ammonia-Soda Process from the Standpoint of the Phase Law.* **P. P. Fedotieff.** (Zeitschr. Phys. Chem. 49. pp. 162–188, Aug. 9, 1904.)—The possibility of the reaction $NaCl + NH_4(HCO_3) = Na(HCO_3) + NH_4Cl$ in aqueous solution gives rise to a four-component system, the components being, for example, any three of the above salts and water. The system is not complicated by any double-salts. The author has carried out at different temperatures exhaustive series of solubility measurements, and plotted the results graphically by means of Löwenherz's tetrahedral coordinates. This affords a complete survey of the conditions of separation of the different solid phases, and indicates the necessary conditions for an economical carrying out of the Solvay process, so far as expenditure of substance is concerned. F. G. D.

3230. *Thermodynamical Deduction of the Conditions of Chemical Equilibrium.* **K. v. Wesendonck.** (Phys. Zeitschr. 5. pp. 521–525, Aug. 15, 1904.)—Instead of deducing these conditions from the principle of increase of entropy (Gibbs, Planck, Riecke, &c.), the author advocates the method indicated by C. Neumann (Ber. der Kgl. Sächs. Gesellsch. der Wiss, 1891, p. 149 *et seq.*), and gives a sketch of the treatment of the subject on these lines. No difficulty attaches to the introduction of the entropy-function into the equations applicable to the reversible changes of a system in equilibrium, as these changes denote simply the passage of the system through a continuous series of equilibrium-states. By the employment of imagined external forces or constraints, the variations of a system, not in equilibrium, can be converted in general into such a series of reversible changes, and from the unrestricted character of these variations the various conditions of equilibrium can be deduced after the fashion of Gibbs. The author shows how the criteria of equilibrium, such as the equality of the chemical potentials in different phases, can be deduced by this method. F. G. D.

REFERENCES.

3231. *Isothermal Surfaces.* **L. Raffy.** (Comptes Rendus, 139. pp. 119–121, July 11, 1904.)—Two mathematical problems on isothermal surfaces suggested by a previous paper [see Abstract No. 2252 (1904)] are here solved. R. E. B.

3232. *Heat Radiation of the Hydrogen Flame.* **O. Tumlirz.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 501–509, March and April, 1904.)—The author shows that the union of 1 gm. of hydrogen and 8 gm. of oxygen gas, at 0° and a pressure of 4·6 mm., to water vapour of the same temperature and pressure should be equivalent to 28,587 gm.-cals.; with certain corrections the heat of combination at t° C. would be $(28{,}652{\cdot}6 + 0{\cdot}3773t)$ gm.-cals. With the apparatus described in Abstract No. 2520 (1904), he finds that when hydrogen is burned in air, 6·15 per cent. of this heat of combustion appears as radiated heat. Assuming that the Hefner lamp burns 0·002678 gm. of amyl acetate per sec., and that the combustion of 1 gm. of amyl acetate yields 7,971·2 gm.-cals., 9·56 per cent. of the heat of combustion of the Hefner lamp would appear as radiated heat. H. B.

3233. *Accumulation of the Solar Heat by Liquids.* **A. v. Kalecsinsky.** (Ann. d. Physik, 14. 4. pp. 843–847, Aug. 2, 1904. Paper read before the Hungarian Academy of Science, Dec. 14, 1903.)—The author filled wooden tubs of 78 cm. depth and 200 litres capacity with solutions of $Mg50_4$, Na_2SO_4, NH_4Cl, Na_2CO_3, and poured fresh water on the top of the salt solutions. Exposed to the sunlight, the salt solutions became warmer than the surface layer of fresh water. When petroleum or olive oil was poured on ordinary water from the mains, the water became much warmer still, but only in the layer immediately underneath the oil or petroleum. The author has been informed of other occurrences of natural accumulators of solar heat [see Abstract No. 1292 (1902)], such salt-lakes being known in Rumania, Norway, and Siberia. H. B.

3234. *High-Temperature Solar Furnace.* (Scientific American, 91. p. 296, Oct. 29, 1904.)—The furnace, which is illustrated, was designed by M. A. Gomes Himalaya, for the purpose of obtaining very high temperatures, using the reflected solar heat. Temperatures above 3,500° C. (higher than that of the electric furnace) are looked for. The reflector is built up of 6,170 elementary mirrors, each 122 × 100 mm., arranged side by side in parallel rows, and are attached by threaded standards to a series of parallel angle irons which run horizontally across the frame. The width at the top is 35 ft., at base 18 ft., and depth 35 ft. With a previously constructed, much smaller furnace on similar lines a temperature of 2,000° C. was obtained. L. H. W.

3235. *New Method for Determining Freezing-points of Fused Electrolytes.* **O. Liebknecht** and **E. Nilsen.** (Ber. Deut. Chem. Gesell. 36. pp. 3718–3721, 1903.)—When the electrical conductivity of a fused electrolyte is measured by Kohlrausch's method at short intervals of temperature (every 5° or 10°), the freezing-point of the electrolyte is marked by a sudden change in direction of the conductivity curve. Carbon electrodes give a sharper minimum than metal ones. With high conductivities, a three-limbed tube of hard glass is best employed, the electrodes being in the outer limbs, and the thermo-element for measuring the temperature in the middle one. Curves are given for various mixtures of commercial salts. The freezing-point of a mixture of potassium chloride and sodium fluoride is identical with that of sodium chloride and potassium fluoride. T. H. P.

3236. *Basicity of a-Aminonitriles.* **M. Delépine.** (Bull. Soc. Chim. 29. 3. pp. 1196–1198, 1903.)—The heat of neutralisation of aminoacetonitrile by sulphuric acid is found to be 19·86 cals. at 21°, and that of α-aminopropionitrile, 20·55 cals. at 14°, those of the corresponding amines—methylamine and ethylamine—being 30·1 and 30·4 cals. respectively; in both cases, therefore, the ethyl compound has the higher heat of neutralisation. The above numbers show that the introduction of a cyanogen group into the α-position reduces the heat of neutralisation by approximately 10 cals. The salts of the two α-aminonitriles undergo but slight dissociation in aqueous solution. T. H. P.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

3237. *Reflection of Electric Waves.* **A. W. Conway.** (Roy. Dublin Soc., Trans. 8. 7. pp. 95–98, April, 1904.)—The author considers the problem of direct reflection at the surface of a perfect conductor bounded by a plane face, and moving in any variable manner without rotation, and developes analysis, founded on that employed by H. M. Macdonald in his treatise on electric waves for the case of conductors at rest, to determine the boundary conditions. G. W. DE T.

3238. *Bending of Electric Waves.* **Rayleigh.** (Roy. Soc., Proc. 72. pp. 40–41, July 8, 1903.)—The author questions the validity of the analysis employed by H. M. Macdonald [see Abstract No. 348 (1904)], on the ground that the shortness of the wave-length involves the result that the important harmonics in the expansion are those of high order in comparison with the ratio of the circumference of the sphere to the wave-length, and that for such harmonics the approximations used are not valid. G. W. DE T.

3239. *Bending of Electric Waves.* **H. Poincaré.** (Roy. Soc., Proc. 72. pp. 42–52, July 8, 1903.)—The author raises a similar objection to that referred to in the preceding Abstract, against H. M. Macdonald's analysis. He doubts whether existing theory is capable of explaining the results obtained by Marconi in long-distance wireless telegraphy, and suggests the possibility that the waves may undergo successive reflection from the upper layers of the atmosphere, rendered sufficiently conducting by their high rarefaction. G. W. DE T.

3240. *Bending of Electric Waves.* **H. M. Macdonald.** (Roy. Soc. Proc. 72. pp. 59–68, July 8, 1903.)—The author gives in this paper a correction and development of his analysis, which shows the criticisms of Rayleigh and Poincaré, referred to in the two preceding Abstracts, to be well founded. G. W. DE T.

3241. *Optical Properties and Electron Theory.* **P. Drude.** (Ann. d. Physik, 14. 4. pp. 677–725, Aug. 2; and 14. 5. pp. 936–961, Aug. 23, 1904.)—These papers are divided into four parts as follows: (1) Normal dispersion of transparent bodies; (2) abnormal dispersion; (3) dispersion of metals; (4) dispersion of the magnetic rotation of the plane of polarisation. Some of the chief results may be thus summarised: 1. By all bodies with normal dispersion the ultra-violet vibrations proper to them are generated by negative electrons, for the ratio e/m (charge to mass) possesses the same value as for kathode rays. 2. By bodies with abnormal dispersion (aniline colours) the absorption bands are due to negative electrons, not to ponderable atoms or molecular masses. 3. For negative electrons the value of e/m derived from the dispersion of hydrogen is $1{\cdot}5 \times 10^7$, *i.e.*, somewhat smaller than the value of Kaufmann, Simon, and Seitz, which, derived from kathode rays, was $1{\cdot}86 \times 10^7$. 4. The effect of the ultra-red proper vibrations on the optical index of refraction for liquids and solids can be approximately calculated by a formula given. 5. From the dispersion a general formula gives an inferior limit, p, to the sum of the electrons in the molecule, which by their motion influence the refractive index. 6. This inferior limit p, in molecules, is obtained by additions from the corresponding values for the parts of which the molecule is built up. The problems of electric conductivity and temperature coefficient of optical properties are also dealt with. [See Abstract No. 542 (1903).] E. H. B.

3242. *Momentum in the Electric Field.* **J. J. Thomson.** (Phil. Mag. 8. pp. 331–356, Sept., 1904.)—For some years the author has made considerable use of the principles proved in "Recent Researches," p. 9, that momentum as well as energy is distributed throughout the electromagnetic field, and that changes in the momenta of magnets, of circuits conveying electrical currents, and other material systems in that field are accompanied by equal and opposite changes in the momentum of the field itself. Thus the system consisting of the field and the material systems in it form a self-contained system, the momentum of which remains constant in magnitude and direction. The basis of the method is the result that at any point in the field the momentum per unit volume is given by $\mu \mathrm{HD} \sin \theta$, where H is the magnetic force at the point, D Maxwell's electric displacement, μ the magnetic permeability, θ the angle between the directions of H and D, and the direction of the momentum is at right angles to H and D. The following cases are then discussed in detail: Pole and charged point, moving charges, charged sphere rotating, charged point at rest placed in field due to moving charged particles, two moving particles, electromotive force due to induction, pressure of radiation. E. H. B.

3243. *Fundamental Hypotheses of Electron Theory.* **M. Abraham.** (Phys. Zeitschr. 5. pp. 576–579, Sept. 15, 1904.)—This paper states the main hypotheses of the electron theory as an extension of Maxwell's electrodynamics, and may be summarised as follows: (*a*) In space devoid of matter and electricity the Maxwell-Hertz equations hold. These postulate a condition in which electric waves may travel in all directions at 3×10^{10} cm./sec. (*b*) Electricity consists of discrete positive and negative particles, called electrons. (*c*) Every electric current is a convection current of moving electrons, and produces the same magnetic field as the equivalent conduction current in the Maxwell-Hertz theory. (*d*) The electromagnetic force is derived from those of the electric field of electricity at rest and the magnetic field of electricity in motion. To the above fundamental hypotheses the author then adds other special ones based upon the recent experiments of Kaufmann and others. (*e*) The electromagnetic forces of the external field and that due to the electron itself maintain, at the electron, an equilibrium in the sense of the mechanics of rigid bodies. (*f*) The electron is incapable of changes of form in general. (*g*) It is a sphere with uniform volume or surface charge. (*h*) In consequence of the earth's motion bodies suffer a definite contraction parallel to the direction of motion. Hypothesis *h* explains the negative results of the experiments of Michelson and Trouton and Noble. (*i*) The quasi-elastic forces which keep the electron at its equilibrium position suffer, in consequence of the earth's motion, the same changes as the electric and molecular forces. (*k*) The electron uniformly charged when at rest, flattens itself when in motion, the diameter parallel to the direction of motion being shortened in the ratio $\sqrt{1-\beta^2} : 1$. It becomes a so-called Heaviside-ellipsoid. (*l*) The masses of the molecules are of electromagnetic nature. The paper concludes with a discussion of the various hypotheses and the evidence of experiments bearing upon the subject.

E. H. B.

3244. *Radiation Reaction on a Moving Electron.* **M. Abraham.** (Electrician, 53. pp. 868–869, Sept. 16, 1904. Paper read before the British Association, at Cambridge.)—The moving electron gives rise to an electromagnetic field, which exerts a force on the electron. For velocities small compared with that of light this force is expressible in the form of a series. Its first term is the product acceleration into electromagnetic mass. The second term is a dissipative force arising from the reaction of the radiation. The electrons emitted by radio-active bodies are moving with very high velocities. W. Kaufmann's experiments show that the β-rays of radium are negative electrons moving with a speed exceeding two-thirds that of light, and if F. Paschen is right, the so-called γ-rays contain electrons moving with nearly, if not quite, the speed of light. The theory, therefore, must be extended to the general case of rapid motion, where $v/c = \beta$ is smaller than, but not small compared with, unity. For the first term the author has previously found the value $-dG/dt$, where G is the vector of the electromagnetic momentum which the electron carries with it. Expressions for the "longitudinal" and "transverse" mass are then given, the latter coming into play in the case of deviation of β-rays. For slow motion, in which the momentum is proportional to the velocity, these two masses are equal, but are different in the general case. The second term of the series is obtained in the form—

$$\frac{2}{3}\frac{e^2}{c^3}\left\{\frac{\ddot{v}}{k^2}+\frac{v(v\ddot{v})}{c^2k^4}+\frac{3\dot{v}(v\dot{v})}{c^2k^4}+\frac{3v(v\dot{v})^2}{c^4k^6}\right\},$$

where $k^2 = 1 - \beta^2$. This is the general expression for the reaction of the radiation on a point-charge, moving with a speed less than that of light. The special cases of uniform motion in a circle and along a helix are then considered.

E. H. B.

3245. *Electric Insulation in "Vacuum."* **Kelvin.** (Phil. Mag. 8. pp. 534–538, Oct., 1904.)—It has been well known that difference of electric potential between conductors in a high vacuum is maintained without appreciable current, even when the distance between them is a small fraction of a millimetre. Fifty or sixty years ago, when we had no experimental knowledge of what is now called a high vacuum, it was a vexed question whether vacuum is an insulator or a conductor. The labours of many experimenters during the last fifty years, and the comparatively modern atomic theory of electricity, have thoroughly confirmed the view that the space of our best modern vacuum and interstellar and interplanetary space, and generally space occupied only by the all-pervading luminiferous ether, is a *very perfect non-resister* of electricity passing through it. Hence we see that the insulation of electricity in "vacuum" is to be explained, not by any resistance of vacant space or of ether, but by a resistance of glass or metal, or other solid or liquid against the extraction of electrions from it, or against the tearing away of electrified fragments of its own substance. Numerical examples now follow in which the outward attractions experienced by the metallic surface under the influence of given electrostatic forces are respectively 16·6 and 66·4 tons weight per sq. cm. The former could be borne by steel wire, but not the latter, the strongest steel scarcely standing a breaking weight of 20 tons per sq. cm. E. H. B.

3246. *Registering Electrometer for the Dispersion of Atmospheric Electricity.* **G. Lüdeling.** (Phys. Zeitschr. 5. pp. 447–451, Aug. 1, 1904.)—At the meteorological and magnetic observatory of Potsdam the author has fixed, 26 m. above ground, a blackened brass ball, 13 cm. in diam.—for which Sprung afterwards substituted a cylinder, 22 cm. in diam.—which is charged from a battery every half-hour, alternatively positive and negative, contact being made for half a minute through two pairs of electromagnets, a long armature beam, and mercury cups. The discharge is then watched for half an hour with the aid of a Benndorf electrometer, records being obtained through the mentioned devices every two minutes. Observations on eight clear days of April, May, and June gave dispersion curves which are parallel to the air-pressure curves, but lag behind them by 3 hours, and appear the inverse of the potential fall curves. The a_- and a_+ curves keep, on the whole, near one another, but the negative ions seem to lag behind the positive ions in the circulation process. Some influence seems to be at work about sunrise and sunset. H. B.

3247. *Measuring the Electric Conductivity and Ionisation of the Air from Balloons.* **H. Gerdien.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 277–299, Sept., 1904. Geophysik. Institut, Göttingen, July, 1904.)—The author modifies his method so as to make his determinations of the conductivity and of the specific velocity of the ions independent of the change in the specific number of the ions [see Abstract No. 1483 (1904)]. Together with H. Elias he made two ascents, on April 14 and May 5, 1904, both from Berlin, starting about 8.30 a.m. and descending about 7.30 p.m. A Bohnenberger electrometer charged with the aid of a Zamboni pile was applied in the first ascent, but the arrangement proved inconvenient. He therefore returned to his aspiration apparatus and electrometer for variable capacity [see Abstract No. 2661 (1904)], making use of the anemometer described in those papers. Guided by Linke's investigation [see Abstract No. 2956 (1904)], he used for the determination of the potential gradient a water-drop collector with a rubber tube (strengthened by a steel wire), 25 m. in length. Part of his ballast consisted of two bags, filled each with 50 litres of water at about 60° C. With the aid of this water-ballast the balloon could be kept at constant level during measurements. The potential gradient becomes small at altitudes above 3,000 m.; it was only 8·5 volts/m. at 5,900 m.; ten minutes after discharging sand-ballast the potential gradient was still far too high, 45 against 8·5 volts. Strong and changeable local charges were met with in strato-cumulus clouds. The electric conductivity does not appear to change between elevations of 4,000 and 6,000 m. The specific ionic velocity increases with the height; the observed values, especially of the positive ions, were greater than would correspond to the gas pressure. The number of free positive ions decreased at high altitudes; that of the negative ions remained unchanged. The measurements give vertical currents of $2{\cdot}1 \,.\, 10^{-18}$ ampere/cm^2; their relation to the height could not be determined as the balloon rose too rapidly, 3,200 m. in 15 min. H. B.

DISCHARGE AND OSCILLATIONS.

3248. *Jet-Shaped Electrical Luminescence in Exhausted Gases.* **J. J. Borgmann.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. No. 7. pp. 239-248, 1904.)—In previous papers the author has described some very beautiful phenomena of luminescence obtained in the exhausted air contained in a tube, round a thin platinum wire located in the axis of this tube, on the wire being connected to one of the terminals of a spark-coil, the other terminal of which was grounded (a spark-gap being connected in shunt to the two terminals) [see Abstract No. 350 (1904)]. It was shown that on the wire being connected to a negative source of electricity, a uniform luminous mist is observed, and that only with the highest degree of exhaustion (that is, if the pressure be reduced to 1 or 2 mm. of mercury) another phenomenon is noted, yellowish-green fluorescent spots appearing on the walls of the glass tube, which are distributed nearly uniformly over the whole length of the tube. Photographs are given showing the luminous effect obtained round a wire in an exhausted glass tube, on the wire receiving an intermittent positive electrification. Interesting luminescence phenomena are also obtained in a tube filled with *carbon dioxide*, at a pressure of some 10 mm., on the wire receiving a periodically intermittent negative electrification. The luminosity takes the shape of jets of liquid, that seem to escape from the wire, striking the walls of the tube, whence they are thrown back. These luminous jets are distributed nearly uniformly alongside the wire. On the pressure of the gas being reduced to 1 or 2 mm. the same source of electricity gives a chain-shaped luminescence (a series of hollow ellipsoids threaded on the platinum wire). On the points of contact of these ellipsoids, some short, luminous lines are observed on the wire, and opposite to these, on the surfaces of the tube, some rings of a yellowish-green colouration due to the fluorescence of the glass. The luminous jets are observed also in nitrogen monoxide, whereas in dry air, oxygen, and hydrogen, they fail to exist; their number increases as the gas becomes more exhausted. A jet-shaped luminescence is obtained also in a tube filled with carbonic acid, and fitted with a disc electrode, if the latter be electrified by means of an intermittent source of negative electricity. If the disc be electrified by an intermittent source of positive electricity, a homogeneous luminous mist is obtained, filling up the whole of the cross-section, while not reaching as far from the electrode as the negative luminosity. This difference clearly shows a different behaviour of positive and negative ions in a gas. All the above-described effects are shown in the photographs illustrating the original paper. A. G.

3249. *Point Discharge.* **M. Toepler.** (Ann. d. Physik, 14. 5. pp. 962-972, Aug. 23, 1904. Physik. Inst. d. techn. Hochshule, Dresden, May 31, 1904.)—The discharge takes place between a very small sphere and a plane, the sphere being negative. The discharge has a thread-like appearance. If curves are plotted connecting voltage and current for a fixed distance apart of the point and plane, then the curves for spheres of different diam. cut each other. For a fixed voltage the current increases with increasing diam. of the sphere, reaches a maximum, and then decreases. R. S. W.

3250. *Movement of Metal Ions in an Electric Arc.* **E. Riecke** and **J. Stark.** (Phys. Zeitschr. 5. pp. 537-538, Sept. 1, 1904.)—An arc is formed between copper electrodes by means of a large accumulator battery. When a bead of lithium chloride is placed near the kathode the red colour is confined to the space between the bead and the kathode; if it is placed near the anode the whole of the arc is coloured, showing the transport of matter in the direction of the current. R. S. W.

3251. *Charging up of an Isolated Conductor in Air.* **J. J. Borgmann.** (Phys. Zeitschr. 5. pp. 542–546, Sept. 1, 1904. Physik. Inst. der k. Universität, St. Petersburg, May 29, 1904.)—During the course of some experiments on the radio-activity of certain muds, an electrode projecting into an earthed cylinder was used. The electrode was first earthed and then insulated, being all the time in communication with a quadrant electrometer. It was found to attain a positive or negative charge according to the nature of the metal used for the cylinder. This is proved to be not due to thermo-electricity or Volta effects. It may be due to the cylinder abstracting one kind of ion from the gas and leaving an excess of the other. R. S. W.

3252. *Oxidation of Nitrogen by the Electric Discharge.* **G. Piaggio.** (Elettricista, Rome, 13. pp. 249–251, Sept. 15, 1904.)—An alternating current (30 ∿) at 4,700 volts is employed, the length of discharge varying from 1 to 6 cm., and the current from 0·018 to 0·4 amp. One electrode is a point and the other a plane, so that the current is rendered asymmetric. The discharge takes place in air, and the air after passing between the electrodes is led through a potash solution to absorb the oxides of nitrogen. It is important that the air should not remain long in contact with the discharge, as this would result in a further change of the oxides formed. The author passes 6 litres of air per min. through the discharge tube. Various curves are given showing the relations between the quantity of oxides of nitrogen produced, and the conditions of the discharge. With constant current, the rate of production of oxides is greater, the greater the distance between the electrodes. With small currents the production of oxides increases rapidly with the current, but the rate falls off as the current increases, and the production eventually becomes constant. With air at 2 or 3 atmospheres pressure a greater production is obtained than at 1 atmosphere, but the production is not proportional to the pressure, the increase tending to fall off as the pressure increases. S. G. S.

3253. *Coherer Action.* **K. E. Guthe.** (Electrician, 54. pp. 92–94, Nov. 4, 1904. Paper read before the St. Louis International Electrical Congress.)—The paper is mainly a review of previous work on the subject, which is valuable in that it includes quite recent researches. A theory of the action is formulated, which is on lines similar to the theories of Lodge and of Guthe and Trowbridge. The strong external electrostatic field is supposed to assist the electrons in leaving the metal and increasing its kinetic energy. These electrons will be carried over and a current results, carried on entirely by the electrons. The passage of electricity is accompanied by a pressure at right angles to the flow, pushing aside the molecules of the dielectric which may have been between the metallic particles—a continuous metallic conductor results; this is for metal-metal coherers. After the impulse ceases there is only a partial return, unless force is used to separate the particles. This theory is then applied to a consideration of the auto-decohering type of coherer. In the filings coherer a mixture of the two cases is probable, and to a certain extent also in all actual coherers. L. H. W.

3254. *Harmonics of Stationary Electric Waves.* **E. Castelli.** (N. Cimento, 8. pp. 161–170, Sept., 1904. R. Istituto Tecnico., Padova, July, 1904.)—The results obtained by Mazzotto concerning the primary and secondary waves in Lecher's apparatus are further examined [see Abstracts Nos. 169, 170, and 1154 (1898)]. The detector used by the author takes the form of a micrometer spark-gap mounted between two conductors, of which one is in contact with each of the parallel wires. By the use of this detector the points of maximum amplitude as well as the nodes can be determined. The method of experimenting is described. It is found that for the first set of harmonics ("primary" of Mazzotto), for which the first node is on the secondary wires, Salvioni's formula is applicable, while for the second set ("secondary" of Mazzotto), for which the first node is on the primary wire, the formula is not applicable. The nodal and antinodal lines are exhibited in a diagram.

S. G. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

3255. *Measurement of Resistance of Electrolytes by Modified Kohlrausch Method.* **E. R. Wolcott.** (Ann. d. Physik, 12. 3. pp. 653–661, Sept., 1903. Physik. Inst., Berlin, July 6, 1903.)—The polarisation capacity of platinum electrodes can be increased by polarising them with a continuous current. This fact has been applied by the author to obviate the difficulty due to polarisation in measuring the resistance of electrolytes by the method of Kohlrausch. If, in this method, unpolarised electrodes of moderate size are used, their small capacity interferes with the balance of the Wheatstone bridge for the alternating currents used in the measurement. If, however, a continuous current is passed into (or out of) the cell by a middle auxiliary electrode, and out of (or into) the cell by the two principal electrodes in parallel, the latter become similarly polarised, and by increasing the continuous current to a certain value their polarisation capacity becomes infinite. The cell then behaves to the alternating bridge currents merely as a resistance, the truc resistance of the electrolyte, which is found by balancing the bridge with the help of a vibration galvanometer or telephone. The author prefers the former. The polarisation capacity was measured by neutralising it with a variable self-induction. Curves are given showing how it increases as the polarising current is strengthened, and how the measured resistance of the cell at the same time diminishes to a minimum. The advantages gained by the method are: (1) The use of small electrodes is rendered possible; (2) they may be made of bright platinum instead of platinised platinum; (3) the measurement of small electrolytic resistances; (4) the substitution of a vibration galvanometer, which is better suited to a large polarisation capacity, for the telephone.

J. D. C.

3256. *Polarisation of the Volta Effect.* **W. Gaede.** (Ann. d. Physik, 14. 4. pp. 641–676, Aug. 2, 1904. Physik. Inst. der Univ. Freiburg.)—The Volta effect between zinc and copper is measured in air, and found to be —0·87 volt. The zinc is then connected to the positive pole of a Wimshurst machine, and placed opposite a platinum point, which is joined to the negative pole. After a discharge has taken place for a few minutes, the plate is removed and the Volta effect again measured. It is found to be —0·611 volt, and gradually increases with time. If the plate of zinc is connected to the negative pole of the Wimshurst, and the Volta effect again measured, it is

—0·96 volt, and it gradually decreases with time. To bring about these effects a passage of electricity between point and plane is necessary. No effect is produced if no current passes; but if the gas between is ionised by radium, or any other agent, the same result follows as for a luminous discharge. These effects the author compares with polarisation effects in electrolytes, hence the title of the paper. R. S. W.

3257. *Conductivity of Solutions of Sodium in Absolute and Aqueous Alcohol, and in Mixtures of Two Alcohols.* **S. Tijmstra Bzn.** (Zeitschr. Phys. Chem. 49. pp. 345–367, Aug. 30, 1904. Extract of Dissertation. Org. Chem. Laborat. Univ. Amsterdam.)—The conclusions to which the author arrives are as follows: Solutions of sodium in methyl alcohol conduct better than those in absolute ethyl alcohol, and these again better than those in propyl alcohol; but the limiting value of the molecular conductivity cannot be experimentally determined, nor calculated by aid of the Ostwald dilution formula. In the case of absolute propyl alcohol, the differences between the values of the molecular conductivity at successive dilutions increase, owing to the great viscosity of the concentrated solutions. The molecular conductivity therefore increases, owing not only to increased dilution, but also to diminished viscosity. Mixtures of ethyl and methyl, and of methyl and propyl alcohol, yield solutions the conductivity of which can be calculated from the values for the pure alcohols. The reason of this is probably that the alcohols do not interact. On addition of water to ethyl-alcohol solutions, the conductivity increases with each dilution; in the case of methyl-alcohol solutions, this is the case only with fairly great concentration (1/4-norm.) As the dilution increases, addition of water first causes a diminution of the conductivity, and then an increase. The cause of this is to be found in the fact that migration velocity of the OCH_3 ion is greater in absolute methyl alcohol than of the OH ion. The reactivity maximum found by Lobry de Bruyn and Steger, and by Lulofs in methyl-alcohol solution, is perhaps to be explained by a smaller alcoholic dissociation of $NaOCH_3$, or of NaOH [see also Abstract No. 366 (1904).] A. F.

3258. *Electricity produced by the Explosion of Hydrogen and Oxygen.* **C. E. Haselfoot** and **P. J. Kirkby.** (Phil. Mag. 8. pp. 471–481, Oct., 1904.) —When the gases are made to combine explosively, a large amount of electricity is generated. The results are very irregular, probably owing to the action of moisture. At least 10 million molecules of water vapour are formed for every pair of ions produced. The energy set free by the explosion is very great compared with the amount required to form the ions, so that their formation may only be a secondary effect. R. S. W.

3259. *Electrical Properties of Aluminium Films.* **W. R. Mott.** (Electrochem. Ind., N.Y. 2. pp. 352–355, Sept., 1904.)—The author has on a previous occasion [see Abstract No. 2174B (1904)] dealt with the physical properties of the films electrolytically formed on aluminium, and in the present paper gives a valuable and exhaustive review of the work which has been done on the electrical properties of such films, as regards specific resistance of the films, critical voltages, and specific inductive capacity. The following is a summary of the author's conclusions. The specific resistances of films in phosphate and sulphate solutions have the values $10·0 \times 10^{10}$ ohm per cm.^{3}, and $0·8 \times 10^{10}$ ohms per cm.^{3} respectively (assuming film to be 0·0001 cm. thick). The specific resistance of the solid film decreases as a logarithmic function of the temperature. The critical voltage may be raised hundreds per cent. by artificial cooling of the electrolyte or electrode. The dielectric strength of films formed with phosphate solutions works out at 10^6 volts per cm. The specific inductive capacity is, however, taken tentatively as of value about 10, which is only $\frac{1}{8}$ the value deduced by Zimmerman [see Abstract No. 2964 (1904)]. The theory of film resistance developed in the paper can, it is thought, be applied equally to the cases of electrodes of Mg, Cr, Bi, Pb, and Cu. L. H. W.

3260. *Use of the Differential Galvanometer for Accurate Resistance Measurement.* **W. Jaeger.** (Zeitschr. Instrumentenk. 24. pp. 288–296, Oct., 1904.)—The comparison of two resistances by the method of adjustable shunts due to Kohlrausch is described. The advantage of this method lies in the fact that it is not necessary to have an equality in the magnetic field, or electrical resistance of the two halves of the galvanometer. It is shown that the two resistances to be compared are equal, when, on reversing the direction of the current in the resistances without reversing it in the galvanometer, equal deflections on the same side of zero are obtained. It is further shown that when the resistances to be compared are each equal to the resistance of one half of the galvanometer, the sensitiveness is equal to that of the Wheatstone's bridge under its most favourable conditions, and that it is superior to that of the Thomson bridge. Also the method of measuring the insulation of the galvanometer coils is indicated. S. G. S.

3261. *Experiments for Improving the Construction of Practical Standards for Electrical Measurements. Anomalies of Standard Cells.* (Electrician, 53. pp. 831–833, Sept. 9, 1904. Abstract of Report of Committee of the British Association.)—The Committee report that the construction of the ampere balance is nearing completion, and also call attention to the comparison up to 1,000° C. of the nitrogen thermometer, platinum resistance thermometer, and platinum-platinum-rhodium couple by Harker. In the appendix by **F. E. Smith**, a description is given of experiments made at the National Physical Laboratory on the preparation of the depolariser for cadmium and for Clark cells, together with results of observations of the e.m.f. of the cells so constructed. Three methods of making the paste are described, the first being long and tedious, the second much shorter and simpler, and the third devised by Carhart, in which the use of concentrated sulphuric acid is not necessary. Dilute acid is used, the formation of the sulphate of mercury being accelerated by passing a current from the mercury to a sheet of platinum foil suspended in the dilute sulphuric acid solution. The product gives identical results with that made by the first two methods. The e.m.f.'s of different forms of cell were measured after 5 min., 20 min., and 3 hours from making up the cells. For the first two sets of observations the temperature of the four limb cells was unsteady, but at the third set the temperature had become constant, and the results were extremely satisfactory. The author also investigated the question of the difference in e.m.f. found by Kahle in 1892 between the Rayleigh H form and the Board of Trade tube form of standard cell, the supposed difference being 0·0004 volt. The differences are found to be very small and irregular, no such difference as 0·0004 volt being observed. The author thinks that the difference found in 1892 is probably attributable to the pastes employed. [See also Abstracts Nos. 1939B and 2276 (1904).] S. G. S.

ALTERNATING CURRENTS AND MAGNETISM.

3262. *Change in Peltier Effect with Temperature.* **E. G. Bausenwein.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 663–678, May, 1904.)—Since $TdE/dt = P$, where E = thermo-electric force, T = absolute temperature and P = Peltier effect, we can determine P and its changes by observing E and T. A circuit of Cu-Fe-Cu had a strong current passed in it—so that the two junctions were raised and cooled respectively in temperature. A constantan wire is soldered to each Cu-Fe junction and the ends of the constantan brought to a galvanometer. Thus by connecting up suitably, the thermo-electric force due to Cu-Fe, Cu-Constantan or Fe-Constantan can be ascertained. The whole Cu-Fe-Cu combination is raised to any desired temperature by an electric porcelain oven, a temperature of 800° C. being attainable. To measure the temperature in the oven, a special thermo-electric pyrometer of platinum-rhodium was used. Tables and curves are given for both thermo-electric force and Peltier effect for Fe-Cu and Fe-Ag. The corresponding curves are very much alike between 0° and 800° C. The results are: (1) The inversion point for Fe-Cu and Fe-Ag is about 300°, which is higher than generally supposed; (2) the right part of the curve is steeper than the left for Fe-Cu and Fe-Ag; (3) in both curves a marked inflection occurs about 700° in the Peltier effect curve; (4) the curves for Peltier effect have at their commencement a parabolic form. P. E. S.

3263. *Galvano-magnetic and Thermo-magnetic Effects in Various Metals.* **H. Zahn.** (Ann d. Physik, 14. 5. pp. 886–935, Aug. 23, 1904.)—On account of the comprehensive electron theory which Drude and Riecke [see Abstracts Nos. 1276 (1900), 840 (1901), and 908 (1903)] have propounded to account for the properties of metals, it is of importance to know the four transversal effects: (1) galvano-magnetic electric effect, (2) galvano-magnetic temperature effect, (3) thermo-magnetic electric effect, (4) thermo-magnetic temperature effect. Using a metal plate of breadth β and thickness δ, through which a magnetic field H acts, passing a current I, and having a transverse potential difference E; then, according to Drude's theory, effect (1) above $R = E\delta/IH$. In like manner the three other effects can be expressed in terms of these or other determinable factors. In order to test Drude's theory the author investigates the coefficient of all these effects for bismuth, antimony, iron, nickel, cobalt, copper, constantan, and carbon. The conclusions arrived at are: (*a*) The four effects can be measured not only in bismuth and antimony, but also in nickel, iron, and cobalt—all on one specimen; (*b*) all the effects can be observed in the temperature range 15°–35°; (*c*) for carbon only the effect (2), and for copper only the effect (4) is observed; (*d*) bismuth shows anomalies, two plates of the same make and of apparently identical composition have different behaviour, hence some material in minute quantities is mixed in one case, not in the other; (*e*) there is partial agreement with Drude's theory, but a number of results seem contradictory to it. P. E. S.

3264. *Velocity of Propagation of Magnetism.* **H. A. Perkins.** (Amer. Journ. Sci. 18. pp. 165–174, Sept., 1904). Oberbeck in 1884 investigated this point. A magnetising coil had as core either a bundle of steel wires or a steel rod. There were two other coils on the core whose distance apart could be varied. The phase angle between the e.m.f. in these coils, when a sinusoidal force was impressed on the main coil, was measured by having the fixed coil in a dynamometer in series with one coil and the movable coil in series with the other. The lag was about 96° when the core was solid and 2° when the bundle was used, other conditions being identical. As regards the influence of distance x alone on flux intensity Q he found a logarithmic curve, $Q = Q_o . e^{-\beta x}$, β being about 10 for soft iron and about 16 for steel. The present author used a somewhat similar apparatus, but the e.m.f. lag was observed by a quadrant electrometer. By connecting the magnetising coil to the electrometer a reading D_a and induced potential V_a is found. Then join the movable coil to the electrometer and get D_b and V_b. On joining the two coils so that the currents conspire we get $V_a + V_b$. On joining so that the currents are in opposition we have $V_a - V_b$. By a vector diagram it is easy to obtain the lag ϕ. It is found that $d\phi/dx$ diminishes as x increases, so that the velocity is not constant, but increases as the flux becomes less. The author concludes (1) that the velocity in metals, especially where permeability is great, is less than in non-conductors; (2) that this decrease is due to eddy currents and therefore diminishes as flux diminishes; (3) that this effect is not a simple function of x, but depends on ohmic resistance and permeability of the bar; and (4) that this retardation is great enough to call for recognition in the design of electro-magnetic machinery.

P. E. S.

ELECTROPHYSIOLOGY AND ELECTROTHERAPEUTICS.

3265. *Artificial and Natural Nerve-stimulation and the Quantity of Energy involved.* **H. Zwaardemaker.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 83–90, July 13, 1904. Proc. pp. 147–153, Aug. 26, 1904.)—Schäfer's method of mechanical stimulation by falling drops of mercury is discussed. The author obtains an effect with a drop of 50 mgm. and a fall of 5 mm. Such a drop possesses at the end of its fall an energy of 24·5 ergs. The energy alone, however, cannot be taken as a measure of the stimulus. A fall of 5 mm. gives an excellent lifting distance when the muscle is loaded with 50 gm., but this distance is lessened when the fall is increased. A capacity-factor as well as an intensity-factor must be taken into account. There must necessarily be a difficulty in estimating the true minimum with mechanical and electrical stimulus, since they are necessarily unsatisfactory. The mechanical stimulus only reaches part of the axis cylinders, and the electrical discharge, although more instantaneous, spreads over the sheaths and the septa between the fibres, as well as over the axis cylinders. As regards natural stimuli there are two organs of sense in which the nerve cells themselves receive stimulus, viz., the organs of sight and smell. The author, by means of an apparatus which is fully described, estimates that the energy capable of causing the impression of an extremely faint glimmer falling on an extremely small area of the retina scarcely measuring 0·002 sq. mm. is, in the case of eccentric vision, of the order of 10^{-10} erg. This quantity would be 100 times less if the eye is completely adapted to darkness. In attempting to calculate the value of the energy of the natural stimulus in the case of the olfactory organ a box of 64 litres capacity is employed, and into this a few drops of the substance, or of an aqueous solution of it, are evaporated. A little air from this space is then sniffed in. It is estimated that ± 0·2 c.cm. of this air is in contact with the olfactory mucous membrane on both sides of the nasal cavity. An estimation is then made of the minimum quantity of the substance which must be present in this amount of air in order that it may be perceived by the sense of smell. The heat of combustion of the substance being known, the amount of energy in this minimum quantity can be determined. Results for different substances vary very greatly. Attempts to find out how much of these substances is absorbed in the olfactory mucous membrane have been unsuccessful. Presumably very little is absorbed, and probably only an extremely small part of the intramolecular energy displays any olfacto-chemical effect. The author considers that the minimum stimulus in the olfactory nerve-terminal will later appear to be of the order of the light stimulus or even smaller. H. W. P. Y.

3266. *Technique of Treatment by Blue Light and Results obtained.* **S. Whitaker.** (Revue Int. d'Électrothérapie, 14. pp. 9–10, July and August, 1904. Abstract of an article by **G. Kaiser** in the Wiener klinische Rundschau, April, 1903.)—The author employs an arc of 15 to 30 amps. with horizontal carbons. This is enclosed in a cylinder which permits movement in all directions. Behind there is a reflector, the end near the patient being open. Between the cylinder and the patient the blue light filter, which is composed of strips of glass, is placed. Half an hour is the usual exposure. When the malady is deep-seated two convex glasses containing a solution of alum, to absorb the heat rays, replace the glass strips, and the affected area is brought into the focus of the lenses. In still more deep-seated lesions a concave lens is interposed in the cone of light coming from the lenses. This arrangement produces a beam of parallel light more or less concentrated and shortens the treatment. The alum solution is constantly changed by a special apparatus. The patient, during treatment, wears tinted spectacles. From his experiences the author draws the following conclusions. That blue light stimulates metabolism to a considerable degree, a result which is chiefly produced by the more refrangible rays; that the blue rays penetrate vascular tissue with ease. Their action is anodyne and promotes absorption; when concentrated it is slightly anæsthetic. Successful cases are quoted. H. W. P. Y.

3267. *Electrical Nerve-stimulation by Alternating Currents.* **W. Nernst** and **J. O. W. Barratt.** (Zeitschr. Elektrochem. 10. pp. 664–668, Aug. 26, 1904. From the Göttinger Inst. für phys. Chem. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen Gesell., May 12–14, at Bonn.)—The authors reject the older theory that rapidly oscillating currents do not exercise a physiological action, because they travel on the surface of the organism. On the contrary, they believe that the passage of the current through the body causes changes in the concentration of the salts in the body fluids, which, however, in the fluids themselves are equalised by diffusion. The cell walls act, however, as semipermeable membranes, preventing this equalisation of concentration by diffusion, and these they consider are the places of stimulation. They deduce theoretically that the current strength required to produce a stimulation increases proportionally to the square root of the oscillation frequency, and experiments show that for frequencies from 100 to 2,000 this law holds. A. F.

3268. *Electrolysis of Metals in Gynecology.* **Laquerrière.** (Archives d'Él. Médicale, 12. pp. 753–754, Oct. 10, 1904. Paper presented at the Congrès de Grenoble de l'Assoc. Franç. pour l'Avancement des Sciences.)—This paper contains the results of researches on the comparative advantages of the different metals when used as electrodes in gynecology. The researches were commenced by Apostoli and completed by Laquerrière after the death of the former. Iron electrodes rapidly deteriorate, and cannot be used after a few times without danger of wounding the mucous membrane. Zinc electrodes sometimes cause more pain than other metals, and are apt to become adherent to the mucous membrane. On the other hand, zinc appears to have antiseptic and caustic properties. Copper and silver possess equal advantages. Their application is not painful and they are easily extracted, especially if the current be reversed for a few seconds. The author believes in the superiority of currents of comparatively high tension, *e.g.*, 60 to 100 milliamps., and prefers for these currents electrodes of metals which are not attacked, as being more convenient; but when it is necessary for some reason to use a weaker current he employs copper, silver, or zinc electrodes, believing that the products formed exert some action on the mucosa.

H. W. P. Y.

3269. *Localisation of Foreign Bodies in the Organism.* **G. Contremoulins.** (Revue Scientif. 2. pp. 362–369, Sept. 17, and pp. 519–524, Oct. 22, 1904.)—In a previous paper [see Abstract No. 2703 (1904)] the author described his method of locating of foreign bodies in the cranium. The apparatus used when the foreign body is in the trunk or limbs differs to some extent, but the principle is the same. A special table is employed, above which there is a frame supported by four uprights. The Röntgen ray tube is carried by a special contrivance which slides along a horizontal bar above the patient. At a lower level is a second horizontal bar which supports a three-branched compass, previously described. The photographic plate is placed in a receptacle below the patient. A preliminary skiagram is taken in order to determine the approximate position of the foreign body. Should this reveal that some special position of the body should be assumed for the localisation and subsequent operation, a record of this position is taken by means of a long flat copper rod, which is moulded to the contours of the limb and body. In this way the position can afterwards be correctly reproduced at any time. The further procedure is much the same as that already described for cranial localisation. In the second paper the author describes his method of localisation by means of the fluorescent screen. The apparatus employed consists of a rigid bar which, by means of a joint, can be held in any position. To this bar three rods are placed at right angles by means of sliding joints. Of these rods, which are all in the same plane, one carries the Röntgen ray tube, that at the extremity of the bar the fluorescent screen in front of which an "indicator of incidence" is fixed, and the middle one carries a second indicator. In using the apparatus it is first necessary to centre the tube, so that the rays project the two indicators in perfect coincidence on the screen. The part of the body in which the foreign body is present, for example, the head, is placed between two indicators and the position arranged so that the shadow of the foreign body coincides with that of the two indicators. The latter are then applied to the skin and the points of contact are marked with a silver nitrate pencil. The head is next rotated through 45° to 50° and the process repeated. The author's three-branched compass previously described is then applied. Two needle-carriers are attached to the compass and to each graduated needle one end of a light semicircular bar, carrying at the other end a second needle, is fixed, the two needles being in the same straight line. The extremity of the graduated needle is then applied to one of the points on the skin, and that of the second needle is applied to the corresponding point on the opposite side of the head, the semicircular needle-holder permitting this. The second pair of needles is applied in the same way to the other two points on the skin. The semicircular needle-holders are now removed. The graduated needles indicate the orientation of the foreign body, and by sliding them towards each other the position which the foreign body occupies can be reproduced and recorded after the compass has been removed from the head. The further procedure does not differ from that described in the previous paper. Another method is described of recording the exact position of the body when the radioscopic localisation is made. H. W. P. Y.

REFERENCES.

3270. *Electromagnetic Field Equations inside Moving Electric Masses.* **E. Kohl.** (Boltzmann Festschrift, pp. 678–686, 1904.)—A highly mathematical treatise, which cannot be abstracted with advantage. E. H. B.

3271. *Mechanical Forces on a Dielectric in an Electromagnetic Field.* **F. Koláček.** (Phys. Zeitschr. 5. pp. 455–456, Aug. 1, 1904.)—A reply to the criticism of R. Gans. [See also Abstracts Nos. 1166 and 1168 (1904).] E. H. B.

3272. *Magneto-Elastic Theory.* **A. Heydweiller.** (Ann. d. Physik, 14. 5. pp. 1036–1038, Aug. 23, 1904. Physik. Institut, Münster, July, 1904.)—The author defends his position against the criticism of R. Gans. [See also Abstracts Nos. 1162 and 1163 (1904).] E. H. B.

3273. *The Normal Electric Field of the Earth.* **H. Ebert.** (Phys. Zeitschr. 5. pp. 499–502, Aug. 15, 1904. Phys. Inst. d. Techn. Hochschule, München, July, 1904.)—In replying to Simpson's criticisms [see Abstract No. 2988 (1904)], the author refers to new experiments described in the Meteorol. Zeitschr., May, 1904, and points out that it was not necessary to assume the whole earth surface to contain radio-active substances. The potential gradient of 100 volts/m. decreased in higher altitudes, and the assumption of vertical air currents of 1 cm./sec. was by no means extravagant, as Gerdien had shown. We did not know anything concerning an electric field above the oceans. H. B.

3274. *Simple Method of Determining the Velocity of Ions in Air.* **H. Mache.** (Phys. Zeitschr. 4. pp. 717–721, Oct. 15, 1903. II. Phys. Inst. der k. k. Univ. Wien.)—The author's method is very similar to that of Gerdien [see Abstract No. 2661 (1904)]. The full results are given. For the specific velocity of the + ions he arrives at $u_+ = 1{\cdot}236$ cm./sec., for the negative ions $u_- = 1{\cdot}409$ cm./sec. The ratio $u_-/u_+ = 1{\cdot}140$. L. H. W.

3275. *Luminosity of Gases in a Tesla Field.* **K. Przibram.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 439–468, March and April, 1904. From the Inst. für theoretische Physik.)—On the lines of Bouty's researches on the dielectric cohesion of gases, except that a rapidly alternating field is used. R. S. W.

3276. *Phosphorus Emanation.* **G. C. Schmidt.** (Phys. Zeitschr. 5. pp. 445–447, Aug. 1, 1904. Physik. Instit., Erlangen, July 3, 1904.)—A reply to those who have criticised the author's theory. R. S. W.

3277. *Spark Discharge in Liquids.* **K. Przibram.** (Phys. Zeitschr. 5. pp. 574–575, Sept. 15, 1904. Physik. Inst., Strassburg.)—Gives the spark-lengths in different organic and inorganic liquids from a given source. E. H. B.

3278. *Electric Waves in Systems of High Capacity and Inductance.* **L. Hermann** and **M. Gildemeister.** (Ann. d. Physik, 14. 5. pp. 1031–1035, Aug. 23, 1904. Physiolog. Inst. Königsberg, July 7, 1904.)—A description of further experiments [see Abstract No. 358 (1904)] with the same object, but this time the condensers had mica insulation instead of paper as before. But in the present experiments also there is a discrepancy between the calculated and observed periods. E. H. B.

3279. *Rotation of a Magnetic Pole.* **P. V. Bevan.** (Cambridge Phil. Soc., Proc. 12. pp. 212–214, Oct., 1903.)—A simple form of lecture apparatus is described to show the rotation of a magnetic pole about a straight conductor carrying a current. Mercury flows from a funnel with a narrow orifice, as a thin jet into a tapered glass tube, which dips vertically below mercury in a vessel. The flow is adjusted so that the tube keeps full or runs over, and so that the mercury column is unbroken from the funnel to the bottom vessel. This forms the straight conductor, and an electric current is passed through it by wires dipping into the mercury in the funnel and the vessel respectively. A thin, light, steel magnet is suspended horizontally on a vertical spindle between one pole and its middle points, consisting of needles resting in glass pivots. The magnet and jet are so placed relatively to each other that, when the magnet revolves on the vertical axis, the jet is wholly outside the circle described by the S-pole, but lies within that described by the N-pole, and is interrupted by it once every revolution. When a current is passed through the mercury column the magnet begins to revolve continuously, its momentum carrying it through the jet. A short, simple proof is given of the electrodynamics involved. J. D. C.

3280. *Peculiar Rotary Effect in an Alternating Magnetic Field.* **H. Axmann.** (Phys. Zeitschr. 5. pp. 554–555, Sept. 1, 1904.)—On a straight iron wire being brought near an electromagnet supplied with alternating current, so that the free end of the wire approaches very near to the core, the far end of the wire being fixed though capable of swinging freely and of rotating, a torque is developed in the wire, which can be communicated to a paper disc for instance. The rotation takes place left-handedly when the point of the wire is placed in a position along a line inclined at an angle of about 135° with the horizontal, and in the opposite direction when in the line at 90° to this. A piece of paper sprinkled with iron filings shows four similar circular regions of activity with no movement in the centre. The author attempts to explain the movement. L. H. W.

3281. *Magnetic Alloys of Non-Magnetic Metals.* **R. A. Hadfield.** (Engineering, 78. p. 308, with Discussion, Sept. 2, 1904. Paper read before the British Association at Cambridge.)—An account is given of Heusler's magnetic alloys of copper, aluminium, and manganese. An alloy exhibited contained 60 per cent. Cu, 25 to 27 per cent. Mn, and 12 per cent. Al ; it was attracted with moderate power by an ordinary horse-shoe magnet. All attempts to forge it had been unsuccessful. [See also Abstracts Nos. 622, 623, and 636 (1904).] F. R

3282. *Values of the Magnetic Elements at Potsdam.* **A. Schmidt.** (Ann. d. Physik, 15. 2. pp. 395–400, Oct., 1904. Communication from the Kgl. Preuss. Meteorolog. Inst.)—The author gives the mean values at the Potsdam Observatory for the years 1902 and 1903. Reference is made to the magnetic storm on Oct. 31, 1903. [See also Abstract No. 169 (1904).]

3283. *Epithelioma of the Temporo-Maxillary Region Cured by Radiotherapy.* **A. Béclère.** (Revue Int. d'Électrothérapie, 14. pp. 33–38, July and Aug., 1904. Bull. de la Société Médicale des Hôpitaux de Paris, p. 627, June 3, 1904.)—This paper contains a detailed account of a case of vegetating epithelioma which was successfully treated by the Röntgen rays. H. W. P. Y.

3284. *The So-called Fleischl Reaction.* **J. L. Hoorweg.** (Archives d'El. Médicale, 12. p. 673, Sept. 10, 1904. Archives für die gesammte Physiol. 99. pp. 619-629, 1903. Journ. de physiol. et de pathol. générales, May 15, 1904.)—Gartner (1904) showed that when a mirror galvanometer and a rheostat are introduced into an induced circuit there is an equal divergence of the needle for each opening and closing of the current and the mirror remains at zero, but when, instead of a rheostat, the human body is introduced into the circuit, the impulse is greater for the opening discharge, and with the successive discharges there is a divergence of the mirror in this direction. The author considers that the phenomenon is the result of condensation, and has shown that it can be produced by other bodies when introduced into the circuit provided that the body is capable of acting as a condenser. Fleischel observed it in 1878 on the cut nerve. In this case the condensation is the result of polarization. Cremer rejects the author's explanation, and attributes the reaction to heat (Joule's law). The author refutes this explanation. H. W. P. Y.

3285. *Capillary Nævus Cured by Phototherapy.* **H. Bordier.** (Archives d'Él. Médicale, 12. pp. 695–697, Sept. 25, 1904.)—A capillary nævus on the face was treated by applications of one hour's duration of the ultra-violet radiations from a Marie's apparatus to each portion of the affected area, taking each in turn. Especial care was devoted to obtaining effectual compression. When the whole area had thus been treated an interval of fifteen days was allowed to elapse in order that the burns produced might heal. After the process had been repeated three or four times the nævus disappeared. H. W. P. Y.

3286. *New Localiser for Radiotherapy.* (Archives d'Él. Médicale, 12. pp. 745–750, Oct. 10, 1904.)—The apparatus consists of a holder movable in all directions on a vertical support. The holder is in the form of a stirrup, the footpiece of which is replaced by a hemisphere of crystal perfectly opaque to the X-rays. The Crookes tube is introduced into the stirrup, and projects into the hollow of the crystal hemisphere. The latter is provided with a circular opening through which alone the rays can pass. To this opening cylindrical tubes of crystal and of varying size can be fitted. The length of the tubes is usually 18 cm., but occasionally shorter tubes are employed. Special care has to be taken, especially with those of small calibre, that they are properly centred. By this arrangement the skin around the part to be treated, as well as the hands of the operator, are effectually protected from the rays. The localiser is made by Dean, of London. H. W. P. Y.

3287. *Pneumatic Rheostat.* **T. Nogier.** (Archives d'Él. Médicale, 12. pp. 784–786, Oct. 25, 1904.)—A new rheostat, primarily for radiotherapic purposes, is described (with illustration), which may, however, be useful for other purposes. A cell of ebonite or other material is provided with two carbon electrodes, one a rod, and the other, only extending half-way down into the cell, tapered to a point. An inner, inverted cell is supported by the cover which fits tightly and is provided with a rubber ball and tube and two cocks. The electrolyte only half-fills the cell, so that the tapered electrode clears the liquid. When it is desired to close the circuit, air is pumped in by the ball and raises the electrolyte to any desired level. On opening the other cock the liquid falls again. The gradation of the current can thus be regulated very finely. L. H. W.

3288. *Röntgen Rays and Tumours. Use of Thiol as Preventative of Röntgen Ray Dermatitis.* **J. Sabrazès.** (Archives d'Él. Médicale, 12. p. 630, Aug. 25, 1904. Finska lakaressallsk, 45. 7. p. 28, 1903.)—A successful case of sarcoma treated by radiotherapy is recorded. Liquid thiol is recommended to be applied to the skin after exposure to the rays as a preventative against dermatitis, and being impermeable to the rays it may also be used to protect healthy skin during exposure. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

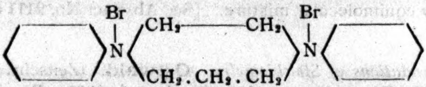
3289. *Viscosity of Mixtures of Hydrazine and Water.* **J. W. Dito.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 110–112, July 13, 1904. Proc. 7. p. 329, Nov. 23, 1904.)—The author uses the apparatus given in Ostwald-Luther's "Introduction" (p. 260), and gives determinations at 25° and 0·0°. To deduce the viscosity strictly the density of the mixtures must be known, but it may be taken as unity. Maximum values are obtained with the approximately equimolecular mixture. [See Abstract No. 2111 (1902).]
H. H. F. H.

3290. *Foundations of Stoichiometry.* **Ostwald.** (Zeitschr. Elektrochem. 10. pp. 572–577; Discussion, pp. 577–578, Aug. 5, 1904. Paper read before the 11 Hauptversamml. d. Deutsch. Bunsen-Gesell., May 12–14, at Bonn. —This paper corresponds more or less to the Faraday lecture. It is first shown that in the statement of the Phase-Law the conception of "number of independent components" can be replaced by the least number of different phases which are necessary in order to manufacture all the phases of the system. The reader is next introduced to the conception of "hylotropic substances." These are substances which pass without change, and completely, from one phase into another phase. Substances which do not behave so are termed solutions. In the case of constant boiling mixtures we have substances which are only hylotropic under certain definite conditions of temperature and pressure. But a true chemical individual is characterised by possessing a "hylotropy," which is independent of temperature and pressure throughout a finite range. For the manner in which the fundamental stoichiometric laws of constant proportions, combining weights and multiple proportions, are deduced without reference to the atomic theory, reference must be made to the original. F. G. D.

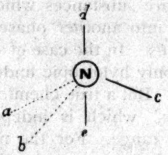
3291. *Ultra-Microscopic Investigation of Solutions of Pure Glycogen.* **W. Biltz** and **Mme. Z. Gatin-Gruzewska.** (Comptes Rendus, 139. pp. 507–509, Sept. 19, 1904.)—A 0·07 per cent. solution of pure glycogen is found to contain numerous extremely small white particles endowed with an oscillatory movement weaker than that of the particles of a colloidal gold solution. The substratum on which these appear also consists of particles which are so small as to be on the very limit of visibility. The number of particles diminishes with the concentration, until with a solution of 1 part of glycogen in 300,000 of water, only one or two are visible in the field of vision. The solutions change with time, a 0·07 per cent. solution showing only very indistinct particles after a period of five days. The size of the particles is also influenced by the conditions under which the solutions are prepared, and by the presence of precipitants. [See also Raehlmann, Abstract No. 513 (1904).] T. H. P.

3292. *Decomposition of Iodoform by the Combined Action of Light and Oxygen.* **E. van Aubel.** (Phys. Zeitschr. 5. p. 637, Oct. 15, 1904. Translated from the French.)—Hardy and Willcock have shown that, in presence of oxygen, iodine is liberated from solutions of iodoform by the action of ordinary light, of Röntgen rays, or of radium emanations. The present author has extended the investigation to the case in which the iodoform forms part of a non-fluid mixture (iodoform and vaseline), and found that here, too, iodine is liberated at the ordinary temperature by sunlight or radium rays. Iodoform in chloroform is not sensibly decomposed by the light of a winter sun, when the temperature of the solution is kept at — 45° C. D. H. J.

3293. *Pentavalent Nitrogen Atom.* **O. Aschan.** (Chem. News, 90. pp. 192–193, Oct. 14, 1904. Paper read before the British Association, at Cambridge.)—By the addition of trimethylenebromide to ethylenedipiperidide, and of ethylene bromide to trimethylenedipiperidide, the author obtains two stereomeric compounds having the constitution—



These cannot be resolved into optically active components by Pope's method with *d*-camphor sulphonic acid, nor by treatment with silver *d*-bromocamphor sulphonate in absolute methyl alcoholic solution, and fractional crystallisation, so would appear to possess symmetrical configurations, which are only possible by assuming the arrangement of the valency directions of pentavalent nitrogen to be—



This conclusion, which has also the greatest probability on mechanico-chemical grounds, confirms the author's previously expressed views on the configuration of ammonium compounds. W. H. Si.

3294. *Active Chlorine.* **D. L. Chapman** and **C. H. Burgess.** (Chem. News, 90. pp. 170-172, Sept. 30, 1904. Paper read before the British Association at Cambridge.)—On exposing a Bunsen and Roscoe actinometer containing a mixture of hydrogen and chlorine prepared by electrolysis, together with a little water, to the action of light, no appreciable movement of the index takes place for some time; then a slight movement is observed, which increases rapidly until, after the completion of the so-called induction period, a maximum and constant rate is attained. If, now, the actinometer is removed from its bath, thoroughly shaken in the dark and re-exposed to light, a new induction period is observed shorter than the first. This may be repeated with the same result, the fresh induction period being always shorter than the one immediately preceding. The same phenomenon appears when the actinometer contains an acid or saline solution in place of water. These results are explained as due to the fact that the power of the gases to combine more readily, or their activity, is removed when they are shaken with water; but in time the water becomes saturated with activity, and it is then no longer able to render the mixed gases inactive. Contrary to the observation of Bunsen and Roscoe, the authors find that the presence of air does not lengthen the induction period. Experiments in which the chlorine and the liquid in contact with it were thoroughly induced show that the induction period is due to the condition of the chlorine. The power possessed by saline and acid solutions of removing the activity from chlorine, is greater than that possessed by water, and with saturated barium chloride solution is about four times as great. An active aqueous solution exposed to the air in an open vessel becomes inactive exceedingly slowly. Active crystals of barium chloride may be prepared, but rapidly lose their activity on exposure to air. An active solution of chlorine in either water or a salt solution is still active after the chlorine has been removed in a vacuum. The above results are not in agreement with the hypothesis which assumes the formation of an intermediate compound, and it is difficult to avoid the conclusion that the exposure of moist chlorine to light results in the augmentation of a physical quantity closely analogous to a potential or temperature. A mixture of active with inactive chlorine assumes, after a short time, the mean potential of the two gases, and combination with hydrogen will not take place on exposure to light. T. H. P.

3295. *Plastic, Flowing, and Liquid Crystals. Forced and Spontaneous Homöotropy.* **O. Lehmann.** (Ann. d. Physik, 12. 2. pp. 311–341, Aug., 1903.)—The phenomenon of liquid crystals was first observed in 1877 in the case of silver iodide, but was not recognised as such. The hexagonal variety is converted above 146° into a regular form, which melts at 450°. On cooling from above 450° the regular modification separates in forms very similar to those of salammoniac, but the whole mass is soft and has the characters of a liquid. The next observation was in the case of cholesteryl benzoate, which behaves in a somewhat similar manner ; but the turbidity of the liquid crystals was contrary to the idea of a homogeneous mass, and it was only subsequently realised that this turbidity was a normal characteristic of solids undergoing deformation ; it was first noticed by Helmholtz in the case of ice, and is due to the varying orientation of crystal structure (with varying refractive index in any given direction) of different parts of the mass ; it was not noticed in silver iodide, as the plastic form is regular and therefore isotropic. The term *homöotropic* is proposed for the *uniform orientation* of the crystal molecules, which often results from the application of tension and compression. The analogy suggested is that of a pile of needles, which, if rolled to and fro between two plates, will ultimately set themselves at right angles to the direction of motion. In the case of the syrupy form of ammonium oleate this effect can be produced by rubbing a cover-glass to and fro. When the experiment is carried out with a polarising microscope the effect is rendered visible by the fact that the extinction of light becomes uniform throughout the field. The homöotropic mass behaves in several respects like a crystal, and retains its structure for some time, especially when no solvent is present and the layer is thin. In presence of a solvent (alcohol) the homöotropic masses are soon broken down into drops by the action of surface tension. Homöotropy may also be produced spontaneously by the action of surface tension. It is also noteworthy that when a clean preparation of *p*-azoxyphenetole is allowed to solidify between clean glass plates, and then continuously heated to the temperature at which it passes over into the liquid-crystal state, the original crystal outlines persist, and the patches between them retain a uniform orientation, and show a uniform extinction between crossed nicols. The author holds that polymorphism, change of state, and the change from a crystalline to an amorphous condition, all involve changes of molecular structure and not mere rearrangement of the molecules. He therefore describes them by the name "physical isomerism." The paper concludes with an interesting modification of van der Waals' theory of change of state, for which reference must be made to the original paper. T. M. L.

3296. *Behaviour of Vanadates in Aqueous Solution.* **P. Düllberg.** (Zeitschr. Phys. Chem. 45. pp. 129–181, Sept. 22, 1903. Physik.-Chem. Institut, Leipzig, April, 1903.)—The constitution of the vanadates in aqueous solution was investigated by means of neutralisation experiments, in which the electrical conductivity of the solutions served as an indicator, although phenolphthalein, methyl orange, and congo red were also used. Freezing-point determinations showed that the metavanadates were trimolecular, *e.g.*, $Na_3V_3O_9$. In solution the pyrovanadates are dissociated in the sense of the equation—

$$Na_4V_2O_7 \rightleftarrows 4\overset{+}{Na} + \overset{----}{V_2O_7}$$

and are not converted into acid orthovanadates—

$$Na_4V_2O_7 + H_2O \rightleftarrows 2Na_2HVO_4 \rightleftarrows 2\overset{+}{Na} + H\overset{--}{VO_4}.$$

On the contrary, the normal vanadates are almost completely dissociated into pyrovanadates and free caustic soda—

$$2Na_3VO_4 \rightleftarrows Na_4V_2O_7 + 2NaOH.$$

Similarly the neutral hexavanadates $Na_4V_6O_{17}$ are decomposed in the solution in the sense of the equation—

$$Na_4V_6O_{17} + H_2O \rightleftarrows Na_3HV_6O_{17} + NaOH,$$

but the acid salts $Na_3HV_6O_{17}$ and $Na_2H_2V_6O_{17}$ are stable. When, however, hexavanadic acid itself is liberated from its salts the yellow solution quickly decomposes, and the pentoxide V_2O_5 separates as a brown precipitate, but redissolves, as a base, on the addition of further quantities of acid. T. M. L.

3297. *Velocity of Dissolution of Solid Bodies.* **L. Bruner** and **S. Tolloczko.** (Acad. Sci. Cracovie, Bull. 8. pp. 555–594, Oct., 1903.)—Further experiments [see Abstract No. 943 (1903)] were made on the rate of dissolution in water of plates of (1) natural alabaster, or macrocrystalline gypsum; (2) homologous organic compounds of the series benzoic acid, phenylacetic acid, and phenylpropionic acid; and (3) acetanilid. Two new forms of apparatus are described, the final form being one in which the crystal plates were let into the sides of a brass cylinder and the liquid stirred by the rotation either of an inner concentric cylinder or by means of a series of blades arranged in a spiral. It was found that in each case the dissolution-constant was a linear function of the speed of the stirrer, and not, as E. Brunner has suggested, proportional to the velocity to the power $\frac{2}{3}$. The relationship found between the velocity of the stirrer and the rate of dissolution does not indicate a zero rate of dissolution at zero speed, but a small, positive value; this is attributed to the fact that the apparatus was subjected to jarring and other disturbances independent of the speed of rotation. With cylindrical stirrers it was possible to deduce the gradient of velocity between the stationary plates and the moving stirrer, and it was then found that equal rates of dissolution were secured when the velocity gradients were the same. The logarithmic law of dissolution was found to hold good within 95 per cent. of saturation. The thickness of the diffusion layer was calculated in all cases, and found to be from 5 to 100μ, and in the case of benzoic acid the value of the diffusion constant was actually calculated from the velocity of dissolution. In the case of arsenic the dissolution is not dependent on diffusion, since the velocity is almost independent of the rate of stirring, and, moreover, is about 1,000 times smaller than in the other cases investigated; probably the dissolution is here dependent on some slow chemical change resulting from the interaction of the arsenious oxide with the water.

T. M. L.

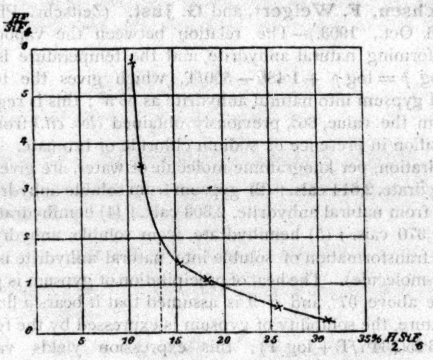
3298. *Gypsum and Anhydrite.* **J. H. van't Hoff, E. F. Armstrong, W. Hinrichsen, F. Weigert,** and **G. Just.** (Zeitschr. Phys. Chem. 45. pp. 257–306, Oct., 1903.)—The relation between the vapour pressure of gypsum in forming natural anhydrite, and the temperature is given by the equation, $\log p = \log p' + 1{\cdot}486 - 500/T$, which gives the temperature of transition of gypsum into natural anhydrite as 63·5°; this is regarded as more accurate than the value, 66°, previously obtained (*loc. cit.*) from experiments on the transition in presence of sodium chloride or bromate. The following heats of hydration, per kilogramme-molecule of water, are given: (1) gypsum from hemihydrate, 2,614 cals.; (2) gypsum from soluble anhydrite, 2,370 cals.; (3) gypsum from natural anhydrite, 2,303 cals.; (4) hemihydrate from natural anhydrite, 1,370 cals.; (5) hemihydrate from soluble anhydrite, 1,638 cals. The heat of transformation of soluble into natural anhydrite is 134 cals. (per kilogramme-molecule). The heat of precipitation of gypsum is positive below, and negative above, 37°, and if it is assumed that it bears a linear relation to the temperature, the solubility of gypsum is expressed by the formula $\log c = 46{\cdot}8675 - 16{\cdot}25(134{\cdot}7/T + \log T)$; this expression yields values in close agreement with those obtained by Hulett [see Abstract No. 1963 (1901)]. In the same way the solubility of anhydrite above 63·5° is given by the equation $\log c = 45{\cdot}3815 - 16{\cdot}25(103{\cdot}9/T + \log T)$, while for the metastable hemihydrate, $\log c = 45{\cdot}7475 - 16{\cdot}25(108{\cdot}5/T + \log T)$. The work done when a kilogramme-molecule of water is taken up by calcium sulphate is expressed by $E = 2T \,.\, \log_e p'/p$, p and p' being the vapour pressures of the hydrate and water at the temperature T. Together with the vapour pressure-temperature relations, this gives the following numbers for E: (1) For gypsum from hemihydrate, $737 - 6{\cdot}88t$; (2) gypsum from soluble anhydrite, $602 - 6{\cdot}48t$; (3) gypsum from ordinary anhydrite, $435 - 6{\cdot}84t$; (4) hemihydrate from soluble anhydrite, $197 - 5{\cdot}28t$; (5) hemihydrate from ordinary anhydrite, $-471 - 6{\cdot}72t$. The transition temperatures are obtained from these expressions by equating them to zero and calculating t. [See also Abstracts Nos. 735 (1902) and 501, 1487 (1903).]

T. H. P.

3299. *Decomposition of some Trichloro- and Tribromo-acetates in Acetone.* **L. D. Kobozeff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 247–255, 1904.)—The author's investigations on the products obtained by the decomposition of potassium hydrogen trichloro- and tribromo-acetates in acetone solutions show that the first change taking place is according to the equation $CX_3{\cdot}CO_2H,CX_3{\cdot}CO_2K = CX_3H + CO_2 + CX_3{\cdot}CO_2K$, where X represents chlorine or bromine. When all the free acid of the acid salt has been decomposed in this way, the water present in the acetone acts on the normal salt remaining, according to one of the following equations: (1) When the water is in excess, $CX_3{\cdot}CO_2K + H_2O = CX_3H + KHCO_3$; (2) when insufficient water is present,

$2CX_3 \cdot CO_2K + H_2O = 2CX_3H + K_2CO_3$. Finally, the chloroform or bromoform, under the influence of potassium carbonate, reacts with the acetone yielding trichloro- or tribromo-trimethylcarbinol. T. H. P.

3300. *Silicic Acid and Hydrofluoric Acid.* **E. Baur.** (Zeitschr. Phys. Chem. 48. pp. 483–503, June 21, 1904. Königl. techn. Hochschule, Munich.)—Daubrée showed that when a mixture of silicon tetrafluoride and steam is led through a hot tube small crystals of quartz are produced. The action $SiO_2 + 4HF = SiF_4 + 2H_2O$ is therefore reversible. The nature of the action was investigated by determining the composition of the vapour obtained from a solution of hydrofluosilicic acid, H_2SiF_6, when saturated with silica. The vapour of this acid was found to contain an excess of silicon tetrafluoride, so that the liquid contains an excess of hydrogen fluoride which is able to dissolve further quantities of silica. The relationship between the concentration of the aqueous hydrosilicofluoric acid saturated with silica and the proportion of HF to SiF_4 in the vapour is clearly shown in the accompanying curve, whilst the concentration of the different constituents in the vapour (expressed in mols. per litre × 10^5) is shown in the table :—



Concentrations (Mols. per Litre × 10^5).

SiF_4.	HF.	H_2O.
198	57·7	2816
59·2	33·1	2978
10·1	12·5	3050
4·65	6·79	3060
2·11	7·37	3063
0·72	4·07	3068

It will be seen that at 13 per cent. H_2SiF_6 the ratio of $HF : SiF_4 = 2 : 1$, so that the acid distils unchanged. T. M. L.

3301. *Dissociation of Electrolytes in Alcoholic Solutions.* **T. Godlewski.** (Acad. Sci. Cracovie, Bull. 6. pp. 239–276, June, 1904. Stockholms Högskolas

Fysiska Institut, April 29, 1904.)—In case the degree of dissociation is small, Ostwald's dilution formula $\left(\frac{\mu}{\mu\infty}\right)^2\Big/\left(1-\frac{\mu}{\mu\infty}\right)v=k$ reduces, as is well known, to the simpler form $\mu^2/v=\mu^2_\infty k=$ const. It is shown in the present paper that for eight organic acids dissolved in absolute ethyl alcohol, the value of μ_2/v is independent of v in each case. The eight acids are salicylic, cyanacetic, bromacetic, monochloracetic, *o*-nitrobenzoic, malonic, orthophthalic, and acetic. In the case of aqueous solutions of these acids the order of arrangement according to values of $\mu^2_\infty k$ coincides with that according to values μk, as μ_∞ does not vary much from acid to acid. Assuming that this also holds true for the alcoholic solutions, it is found that the order of arrangement of the acids, according to the value of the dissociation constant, differs according to the solvent (alcohol or water). Not only does Ostwald's dilution formula hold for solutions in pure alcohol, but it is shown also to hold good for the acids salicylic, cyanacetic, and bromacetic in all mixtures of alcohol and water. In amyl alcohol acetic acid behaves abnormally, the molecular conductivity possessing a minimum at about half-normal concentration. F. G. D.

3302. *Acid Nitrates.* **E. Groschuff.** (Zeitschr. Anorg. Chem. 40. 1. pp. 1–23, June 23, 1904. Ber. Deut. Chem. Gesell. 37. pp. 1486–1493, 1904.)—An important paper on the double salts formed by the combination of nitric acid with alkali nitrates. (1) *Ammonium salts.*—When ammonium nitrate is dissolved in nitric acid (sp. gr. 1·5) in the proportions indicated by the formula NH_4NO_3, $2HNO_3$, the whole mass crystallises when cooled, and melts again at 29–30°. This melting-point is lowered by the addition of water, nitric acid, or ammonium nitrate, and indicates the presence of a definite compound of the above formula. A labile dinitrate, NH_4NO_3, HNO_3, also exists, which melts at 12° C., but this compound has the same composition as the eutectic mixture of mononitrate and trinitrate, and unless special conditions are used these two salts separate from the solution rather than the labile dinitrate. The eutectic melts at 16° C. (2) *Potassium salts.*—The trinitrate KNO_3, $2HNO_3$, melting at 22°, is stable. The dinitrate is stable between its eutectic temperature with the trinitrate at 21–22° and the transition temperature 28–29°, at which it dissociates into mononitrate and free acid. The solubility of potassium nitrate in water is at first decreased by the addition of nitric acid and then increased. The amount of nitric acid required to cause the separation of trinitrate from the saturated aqueous solution becomes less as the temperature is lowered. T. M. L.

3303. *Catalytic Reactions at High Temperatures and Pressures.* VIII. **W. N. Ipatieff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 786–813, 1904. Ber. Deut. Chem. Gesell. 37. pp. 2961–2985, 1904.)—Investigation of the decomposition of alcohols at high temperatures and pressures, in the presence of iron as catalyst, leads to the conclusion that increase of pressure diminishes the decomposability of alcohols, and although the course of the reaction is the same as under the ordinary pressure, yet the products of the reaction—especially the gases formed—differ in composition from those obtained under atmospheric pressure. The substances examined were methyl, ethyl, propyl, and amyl alcohols, aldehyde, *iso*propyl alcohol, acetone, and dimethylethylcarbinol. The decomposition of primary, secondary, and tertiary alcohols differs as regards both the products formed and the velocity, which may be taken as approximately proportional to the rate of increase of pressure. Curves showing the increase of pressure with time were constructed and the maximum values of dP/dT determined; it is found that the product of this maximum value, with the time after which it is arrived at, is a constant: $(dP/dT)_{max.} T = \text{a const.} = R$. This constant R holds moderately well, not only at different temperatures for one and the same alcohol, but for all primary alcohols, and may serve as roughly representing the relative amounts of energy transformed by different catalysts in the complete decomposition of organic compounds. The geometrical representation of the above relation will be a rectangular hyperbola, in which the product of the co-ordinates is a constant. For primary alcohols, the value of R is about 800 (using the atmosphere and minute as units), and in the decomposition two processes take place: (1) Formation of hydrogen and aldehyde, and (2) resolution of the latter into a saturated hydrocarbon and carbon monoxide. For secondary alcohols and for aldehydes (where only one reaction takes place) the value of R is only half as great. In the decomposition of primary and secondary alcohols in presence of catalytic iron under high pressures, no separation of carbon is observed such as is met with under the ordinary pressure, and all alcohols at high temperatures undergo a special decomposition, to which the name paraffinoid may be given, as the gases formed consist mainly of saturated hydrocarbons. T. H. P.

3304. *Catalytic Reactions at High Temperatures and Pressures. Dissociations in the Phenomena of Catalysis.* IX. **W. N. Ipatieff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 36. pp. 813–835, 1904. Ber. Deut. Chem. Gesell. 37. pp. 2986–3005, 1904.)—[Compare preceding Abstract.] Investigation of the decomposition, in presence of alumina as catalytic agent, of alcohols in closed vessels under high pressures and at definite temperatures shows that the alcohols undergo decomposition into olefines and water, just as is the case under the ordinary pressure; the temperatures at which the catalytic decompositions occur are, however, higher than under atmospheric pressure. But it is found that, at temperatures lower than those at which the olefines are formed from primary alcohols, one molecule of water is given up by two molecules of alcohol, an ether being formed. This reaction is reversible, the ether again yielding the alcohol under the influence of alumina. At higher temperatures, the ether undergoes further decomposition into olefine and water. At still higher temperatures, the olefine, and also the aldehyde formed by the hydration of the ether, are decomposed, yielding gaseous products partially similar to those formed during catalysis by iron. The pressure curves for certain primary, secondary, and tertiary alcohols and ethyl ether have been constructed and the values of R determined [see preceding Abstract]; these are found to have about half the corresponding values for catalysis with iron. Moreover, under the ordinary pressure, ethyl ether is formed in the decomposition of ethyl alcohol, but only in very small quantities; in the same way ethyl alcohol is always formed in the catalytic decomposition of ether under the influence of alumina under the ordinary pressure. T. H. P.

3305. *Complex Ammonia Hydroxides of Copper, Nickel, Cadmium, Zinc, and Silver.* **W. Bonsdorff.** (Zeitschr. Anorg. Chem. 41. 1. pp. 132–192, Aug., 1904. Extract from Helsingfors University Thesis. Anorg. u. Phys.-chem. Abt. des Chem. Universitätslaborat., Breslau.)—The results of potential measurements by Bodländer's method show that the complex kathion of cadmium ammonium hydroxide has the composition $Cd_m(NH_3)_{4m}$; similarly the kathion of zinc ammonium hydroxide has the formula $Zn_m(NH_3)_{3m}$. With copper and nickel constant potentials could not be attained. Conductivity measurements of solutions of cupric hydroxide in ammonia show that, when the concentration of the ammonia is small, one or more weaker copper-ammonia bases are present in the solution. Comparison of the conductivity curves of cupric hydroxide + ammonia with those for barium hydroxide + ammonia indicates that when the concentration of the ammonia is from 3- to 4-normal or less, a stronger copper-ammonium base prevails in the solution. The number of the combined ammonia molecules in the stronger base is probably larger than with the weaker one, and comparison of the cupric hydroxide-ammonia solutions with the corresponding copper-sulphate solutions gives the number of ammonia molecules in the stronger base as four. Conductivity measurements of nickel or cadmium hydroxide or silver oxide in ammonia show that here also strong bases are formed with ammonia. Zinc hydroxide, however, forms only very feeble bases with ammonia. These results are confirmed by measuring the concentrations of the hydroxyl ions by Koelich's method. Solubility measurements of copper, nickel, cadmium, and zinc hydroxides in ammonia show that these hydroxides readily undergo change, although it is very difficult to obtain definite modifications. With copper, however, it is found that when the excess of ammonia is relatively small, each atom of copper takes up two molecules of ammonia, while an atom of cadmium or nickel takes up four ammonia molecules.

T. H. P.

3306. *Complex Compounds of Molybdic and Tungstic Acids with Organic Acids.* **H. Grossmann** and **H. Krämer.** (Zeitschr. Anorg. Chem. 41. 1. pp. 43–60, Aug., 1904. Physik. Institut der Universität, Münster.)—The authors conclude from their experiments that in solutions containing one molecule oxalic, malic, or tartaric acid to one molecule sodium molybdate or tungstate, one must assume the presence of neutral salts of dibasic complex acids, which, at fairly great dilution, are hydrolytically dissociated. The hydrolytic dissociation of the complex molybdates is greater than in the case of the tungstates. Analogous di-sodium complex salts are formed in the case of citric acid. The view held by Gernez that tartaric and malic acids form complexes with sodium molybdate and sodium tungstate, which vary in composition according to the amount of the salt added, is not valid for the concentrations studied by the authors. It is very probable that for all the cases investigated, the tri-oxides of molybdenum and tungsten are attached to the carbonyl group of the organic acids. The salts corresponding to those obtained by Henderson and Prentice [see Abstract No. 1353 (1903)] undergo hydrolytic decomposition in the concentrations employed. A. F.

3307. *Preparation of Colloidal Metals.* **N. Castoro.** (Zeitschr. Anorg. Chem. 41. 1. pp. 126–131, Aug., 1904. Agrikultur-chem. Laborat. des eidg. Polytechnikums, Zürich, June, 1904.)—The author uses acrolein for the preparation of solutions of colloidal metals. On adding acrolein to a hot, faintly alkaline solution of gold chloride, the hydrosol appears with a sky-blue, amethyst, violet, rose-red, or purple-red colour according to the dilution. With dilute neutral solutions, a gold mirror is obtained. On heating 100 c.cm. of a 0·25 per cent. solution of aurichloric acid with 1 c.cm. of ethyl alcohol, it assumes firstly a pale violet and later a ruby-red colouration. Such solutions deposit no gold in ten days, but the parchment paper used in their dialysis exhibits a number of black points, possibly of the same nature as the rings observed by Zsigmondy. After three or four weeks the solutions separate into two sharply-defined layers, the upper being pale red and the lower very dark red. An amorphous precipitate, soluble in water, is gradually deposited. Colloidal solutions of platinum, palladium, osmium, and ruthenium can also be prepared by means of acrolein. T. H. P.

3308. *Polarisation of Galvanic Cells in Presence of Solid Salt.* **W. Jaeger.** (Ann. d. Physik, 14. 4. pp. 726–741, Aug. 2, 1904. Communication from the Physikalisch-Technische Reichsanstalt.)—The author has studied, more especially in reference to the cadmium cell, the production and disappearance of polarisation produced by a constant current in a cell with solid cadmium sulphate. The main results can be summarised as follows: Galvanic polarisation due to change of concentration with a constant current when solid salt is present, reaches a state of dynamic equilibrium which is determined by the diffusion constant, and the velocity of solution and of crystallisation, a_1 and a_2, of the particular salt. The production and disappearance of polarisation, on stopping the current, occur in an analogous manner, and are conditioned by the integral $F(at) = \frac{2}{\sqrt{\pi}}\int_{\sqrt{at}}^{\infty} e^{-v^2}dv$. If K represents the maximum difference of concentration between the concentration c at any moment and the concentration c_0 at saturation, corresponding to the dynamic equilibrium, then $\frac{c}{c_0} = 1 - K\{1 - F(at)\}$ for the production of polarisation; and $\frac{c}{c_0} = 1 - KF(at)$ for the disappearance. For $t = 0$, $F(at) = 1$; for $t = \infty$, $F(at) = 0$. The author shows how the magnitude of polarisation can be calculated from the above equations for dilute solutions. From experimental determination of the change of polarisation with time, it is possible to calculate the value of a, or the constant of solution or crystallisation of the salt. It follows from the work of the author that in the use of such cells, the danger of polarisation is generally over-estimated, since polarisation disappears as rapidly as it is produced. The more finely the salt is divided, the smaller must be the polarisation. If solid salt is absent, the conditions are altered, diffusion alone being the determining factor. A. F.

3309. *Catalytic Oxydation of Iodine to Hypo-iodite.* **J. Brode.** (Zeitschr. Phys. Chem. 49. pp. 208–216, Aug. 9, 1904. Elektrochem. Inst., Karlsruhe.)—The decomposition of H_2O_2 and the combination of H_2O_2 and H_2 are compared. From experimental data the velocity constant of the first is nearly twice that of the second, in agreement with the equations. Conclusions are drawn as to the velocities of other reactions between the same substances. The reaction given by $H_2O_2 + 2Na_2S_2O_3 + 2H = 2H_2O + N_2S_4O_6 + 2Na$ follows the same law and has the same velocity-constant as the second. This is explained by the presence of an intermediate reaction $H_2O_2 + J' = H_2O + OJ'$, where J′ stands for iodine ions. H. H. F. H.

3310. *Catalysis of Ethyl Acetate by Nitric Acid in Presence of Alkaline Nitrates.* **H. Lundén.** (Zeitschr. Phys. Chem. 49. pp. 189–198, Aug. 9, 1904. Stockholms Högskolas, Fysiska Institut, April, 1904.)—The velocity of the catalytic hydrolysis of ethyl acetate by nitric acid is increased by alkaline nitrates, the increase being 2·3 per cent. per 0·1 equivalent, when the ordinary method of calculation is employed. The author, however, expresses the effect due to all the various sorts of ions present by the formula $K_{HNO_3} = Am_H\{1 + am_H + bm_{Na} + dm_{NO_3}\}$, where K = velocity-coefficient, m_x = concentration of the ion x, and A, a, b, d are constants. In the case of hydrochloric acid and alkaline chlorides, the velocity-coefficient can be expressed by a formula of the same type—$K_{HCl} = Am_H\{1 + am_H + bm_{Na} + cm_{Cl}\}$, although the effects produced by hydrochloric acid and chlorides are quantitatively different (unlike the case of sugar-inversion, where the "salt-action" of HCl is the same as that of HNO_3). F. G. D.

3311. *Serumtherapy from the Physico-Chemical Standpoint.* **S. Arrhenius.** (Zeitschr. Elektrochem. 10. pp. 661–664; Discussion, pp. 664 and 668–679, Aug. 26, 1904. Report read before the 11th Hauptversamml. der Deutsch. Bunsen-Gesell., May 12–14, at Bonn.)—The author here gives a *résumé* of his work and views on the application of the law of mass action to the study of toxins and anti-toxins [see Abstracts Nos. 1110 (1903) and 1553 (1904)], which is of the highest importance, and for which reference should be made to the original papers. The discussion which followed was very thorough, so that the above report constitutes a good summary of the present position of the problem of immunity. In the *discussion,* **W. Biltz** put forward the view that in the interaction between toxins and anti-toxins we are dealing with absorption phenomena between colloids, and points out several analogies in the behaviour of the two classes of phenomena. He also communicates the results of experiments on the anti-toxic action of colloidal ferric hydroxide towards arsenic [fully given in Ber. Deutsch. Chem. Gesell. 37. 3138 (1904)], which resembles the action of an anti-toxin towards a toxin. **Ostwald,** however, pointed out that the analogy is not complete, and referred especially to the difference in the order of the exponents in the formulæ representing the two cases; a point on which he laid great stress. The analogy between colloidal substances and toxins and anti-toxins was also emphasised by **Zangger. P. Ehrlich** criticised some of the statements of the author. He upholds his well-known position, and more especially that in the "neutralisation" of toxin by anti-toxin we are dealing with several toxic bodies and not with a single toxin and anti-toxin, as the author assumes. Interesting additions to the discussion were also contributed by **G. Bredig, Nernst,** and **Coehn.** No definite conclusion was, however, arrived at, although the importance of attacking the problem from a quantitative physico-chemical standpoint becomes more and more clear. A. F.

3312. *Velocity of Substitution of a Nitro-group in* O- *and* P-*dinitrobenzene by an Alkoxyl Group.* **A. Steger.** (Zeitschr. Phys. Chem. 49. pp. 329–332, Aug. 30, 1904. Organ.-Chem. Laborat. der Univ., Amsterdam.)—The reaction $C_6H_4(NO_2)_2 + NaOX = C_6H_4(NO_2)OX + NaNO_2$, where $X = CH_3$ or C_2H_5, and the corresponding alcohol is employed as solvent, proceeds quantitatively according to the bimolecular velocity-equation. The velocity-coefficient is independent of the dilution, and is not affected by the addition of sodium nitrile or acetate. It happens, therefore, to be independent of the electrolytic dissociation of the alcoholate, unlike the reaction (ether-formation) between alkyl iodide and alkali alcoholate. F. G. D.

3313. *Influence of Water on the Velocity of Ether-formation, and the Distribution of Sodium between Water and Methyl or Ethyl Alcohol.* **C. A. Lobry de**

Bruyn and **A. Steger.** (Zeitschr. Phys. Chem. 49. pp. 336–340, Aug. 30, 1904. Organ.-Chem. Laborat. der Univ., Amsterdam.)—The influence of dilution of the solvent with water on the speed of the following reactions has been studied:—

MeI + NaOMe = MeOMe + NaI (in methyl alcohol).
MeI + NaOEt = MeOEt + NaI (in ethyl alcohol).
EtI + NaOMe = MeOEt + NaI (in methyl alcohol).
EtI + NaOEt = EtOEt + NaI (in ethyl alcohol).

The ether-formation obeys the bimolecular velocity-equation both in alcoholic and aqueous alcoholic solutions. The effect of dilution of the solvent with water is to continuously diminish the velocity-coefficient in the case of ethyl alcoholic solutions, whilst for methyl alcoholic solutions the coefficient is at first increased and then diminished. From the results of their experiments the authors draw interesting, although not quite convincing, conclusions as regards the distribution of sodium between alcohol and water in the aqueous-alcoholic solutions. For example, the velocity-coefficient of the reaction between ethyl iodide and a solution of sodium in pure water does not differ much from the coefficient in the case of a 50 per cent. alcoholic solution. In the former case the reaction occurring is EtI + NaOH = NaI + EtOH. It would appear natural to assume that in the 50 per cent. solution it is chiefly this reaction which occurs, and hence that the sodium mostly exists as hydrate in such a solution. But the authors show that the output of ether in this case amounts to about 74 per cent. of the theoretically possible. For this and other reasons it is concluded that in aqueous-alcoholic solutions a very considerable amount of sodium is present as alcoholate. The question, however, is complicated by the unknown effect of the change of medium on the velocity-coefficients. F. G. D.

3314. *Influence of Water on the Velocity of Substitution of a Nitro-group in* O-*dinitrobenzene by Methoxy- and Ethoxy-groups.* **C. A. Lobry de Bruyn** and **A. Steger.** (Zeitschr. Phys. Chem. 49. pp. 333–335, Aug. 30, 1904. Organ.-Chem. Laborat. der Univ., Amsterdam.)—The reaction $O - C_6H_4(NO_2)_2 + NaOX = O - C_6H_4 . (NO_2) . OX + NaNO_2$, where $X = CH_3$ or C_2H_5, is studied in alcoholic and aqueous-alcoholic solutions. It follows the bimolecular velocity-equation. In the case of ethyl alcoholic solutions the effect of adding water to the solvent is to continuously diminish the velocity-coefficient, whilst for methyl alcoholic solutions the velocity-coefficient is increased (as far as a solvent containing 50 per cent. water). Owing to the relatively small stability of orthodinitrobenzene in water, complete series (from 100 per cent. alcohol to 100 per cent. water) could not be carried out. It is evident, however, that in aqueous-methyl alcoholic solutions the velocity-coefficient will possess a maximum in the neighbourhood of the 40 per cent. alcohol solvent. F. G. D.

3315. *Velocity of Substitution of Halogen by an Alkoxyl-group in some Nitro-halogen Derivatives of Benzene.* **P. K. Lulofs.** (Zeitschr. Phys. Chem. 49. pp. 341–344, Aug. 30, 1904. Organ.-Chem. Laborat. der Univ., Amsterdam.)—The reaction $C_6H_3(NO_2)_2Cl + NaOX = C_6H_3(NO_2)_2OX + NaCl$, where $X = CH_3$ or C_2H_5, proceeds quantitatively in a solution of the corresponding alcohol (CH_3OH or C_2H_5OH) according to the bimolecular velocity-equation. In the case of ethyl alcoholic solutions, change of the solvent from 100 per cent. alcohol to 60 per cent. alcohol + 40 per cent. water continuously diminishes the velocity-coefficient, whilst in methyl alcoholic solutions dilution of the solvent with water first increases and then diminishes the velocity-coefficient. Similar results have been obtained by Lobry de Bruyn and Steger [see preceding Abstract]. For further details concerning these highly interesting investigations, reference must be made to the original paper. [See Recueil des Trav. Chim. des Pays-Bas, 20. 292, 1901.]

F. G. D.

3316. *Theoretical Discussion of Reactions which take place in Two or more Successive Phases.* **C. L. Jungius.** (Zeitschr. Phys. Chem. 49. pp. 368–375, Aug. 30, 1904.)—Chemical reactions which apparently take place in one phase, but in reality in two or more, may be reversible, and incomplete reactions can also occur the order of which does not agree with the number of molecules in the chemical reaction-equation, but depends in a complicated manner on the concentration of the reacting molecules. In the case of the reaction $2CO = C + CO_2$ it is shown that the usual equation $dx/dt = kC_1^m C_2^n \ldots - k'C_2'^{m'} C_1'^{n'} \ldots$. will not in general be applicable, and that experiments need not lead to any definite order of reaction. For the determination of the equilibrium constant, however, the chemical equation can be used without disadvantage.

A. F.

3317. *Ultramicroscopic Observations.* I. *Separation of Sulphur from Thiosulphuric Acid and of Selenium from Selenious Acid.* **W. Biltz.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 4. pp. 300–310, Sept., 1904.)—The author has made use of the ultramicroscope invented by Siedentopf and Zsigmondy [see Abstract No. 1169 (1903)] to study the condition under which sulphur separates from thiosulphuric acid and selenium from selenious acid. When a solution of sodium thiosulphate was acidified by oxalic acid, the liquid remained optically empty, and then particles made their appearance. This appearance of particles as viewed with the ultramicroscope coincides with the appearance of opalescence as seen with the naked eye. The author therefore concludes that there is first formed a true supersaturated solution of sulphur in water, and that after a time supersaturation ceases and particles make their appearance. In the case of selenium, the selenious acid solution remained optically empty for from 2 to 10 min.; particles were then formed during a period of from half a min. to three min., after which time only increase in the size of the particles occurred.

A. F.

3318. *Ageing of Clay.* **P. Rohland.** (Zeitschr. Anorg. Chem. 41. 2. pp. 325–336, Sept. 22, 1904. Techn. Hochschule, Stuttgart.)—The plasticity of clay and porcelain material is well known to be increased after prolonged storage in a damp place. This change has been variously ascribed to purely chemical changes (oxidation of sulphides), to mechanical causes (percolation of gases), and to the action of bacteria. The present author amplifies the views of Leger, who showed that the attainment of the plastic state was accelerated by the addition of small quantities of substances containing free hydrogen ions. The present author has tested these views by further experiments, and arrives at the following views as to the nature of plasticity and of the ageing process in clay substances: (1) Materials capable of entering into colloidal solutions with water also possess the property of plasticity in greater or less degree. (2) Clay and porcelain materials contain such colloidal bodies, partly inorganic and partly of organic character. The peculiar union of these bodies, dissolved in water, with the clay-substance proper, silicate of alumina, is to be regarded as the cause of plasticity. The ratio of the inactive substances (silicates, &c.) M to the active substances (colloids in solution) N, $= M/N$, is a measure of the degree of plasticity. (3) The coagulation of the colloidal solutions contained in porcelain materials may be accelerated by the catalytic action of certain substances. (4) Hydrogen and hydroxyl ions are active agents in accelerating this coagulation. (5) and (6) The rate of such catalytic action of hydrogen and hydroxyl ions is approximately directly proportional to their concentration, but the coagulation produced by hydroxyl ions is only temporary. (7) The increased plasticity due to ageing may therefore be explained by supposing that the hydroxyl ions contained in the solutions in contact with the materials are neutralised by the fermentation (due to bacteria or ferments) of the organic substances, so that an excess of hydrogen ions is formed, and these accelerate coagulation and thus hasten the appearance of plasticity. (8) The laws of shrinkage of clays may be explained by regarding them, not as tough homogeneous bodies but rather as an aggregate of cells or pores filled with fluid. (9) The degree of plasticity of clays can be increased by the addition of colloid substances such as tannic acid, dextrin, or alumina hydrate. W. Ros.

3319. *Carbinol Salts and Cyclohexanerosanilines: Decolourisation Phenomena.* **J. Schmidlin.** (Comptes Rendus, 139. pp. 521–524, Sept. 26, 1904.) —The author has previously shown that the molecule of rosaniline contains four double linkages, thus excluding Rosenstiehl's formula, which possesses only benzene nuclei, and hence only aromatic double linkings. The quinone formula given by Fischer and Nietzki, however, explains the existence of these cyclohexanerosanilines. The passage of the white substances, on heating, into the black salts with the loss of four molecules of water, is a direct proof for the quinonoid structure of these salts. The further study of the decolourisation of the fuchsines by excess of mineral acid leads to the following conclusions: Under these conditions the fuchsines form colourless solutions by taking up four molecules of water and changing the quinone nucleus into a hexahydrobenzene nucleus, thus passing into the tri-hydrochloride of tetraoxycyclohexanerosaniline. Since the latter is identical with the intermediate compound formed in the action of a small quantity of acid on the rosanilinecarbinols, it follows that in the neutralisation of the latter by an acid, the benzene nucleus changes first into hexahydrobenzene and then into a quinone nucleus. [See also Abstract No. 2207 (1904).] T. H. P.

3320. *Aluminium Hydrate.* **F. Russ.** (Zeitschr. Anorg. Chem. 41. 2. pp. 216–230, Sept. 22, 1904. Technolog. Gewerbe-Museum, Wien, June, 1904.) —This paper is a contribution to the study of the process of K. J. Bayer (extraction of alumina from bauxite), and deals therefore with the conditions which control the separation of aluminium hydrate from solutions of sodium aluminate. For solutions containing alumina and alkali in the ratio $Al_2O_3 : Na_2O = 1 : 1{\cdot}24$, it is found that dilute solutions (sp. gr. 1·013) yield a small amount of colloidal hydrate, while concentrated solutions (sp. gr. 1·570) yield a small amount of "crystalline" hydrate. Solutions of medium concentration deposit a much greater quantity of the crystalline form. The maximum yield (86 per cent. of the dissolved alumina) is obtained from a solution of sp. gr. 1·2. This crystalline hydrate (β-modification) when filtered off, washed, and dried over H_2SO_4 for two days, possesses the composition

$Al_2O_3 . 3H_2O$. The author's conclusions are that this crystalline β-modification is the stable form into which the colloidal α-form tends to pass, that this transformation is accelerated by the presence of hydroxyl ions, and that the solubility of the β-form is greatly increased by an increase of hydroxyl-concentration. The β-form is chiefly distinguished from the α, or "young," modification by its resistance to the solvent influence of normal H_2SO_4. This difference is, however, rather a quantitative than a qualitative one. The β-form, although usually termed crystalline, exhibited no indication of crystalline structure under the microscope. The difference between the so-called colloidal and crystalline forms is therefore not that of two sharply differentiated phases. F. G. D.

3321. *Equilibria in Solutions of Silver Salts.* **R. Lucas.** (Zeitschr. Anorg. Chem. 41. 2. pp. 193–215, Sept. 22, 1904. Elektrochem. Laborat. der techn. Hochschule, Braunschweig.)—A study of the reversible reactions—

$$Ag . Ag(CN)_2 + KX \rightleftharpoons K . Ag(CN)_2 + AgX,$$

where $X = Cl$, Br, or CNS, and where $Ag . Ag(CN)_2$ and AgX are present as solids, leads to the mean value $2{\cdot}2 \times 10^{-6}$ for the solubility of silver cyanide at 25° C., assuming from known data the following solubilities at 25°: AgCl $1{\cdot}41 \times 10^{-5}$ (Thiel), AgBr $8{\cdot}1 \times 10^{-7}$ (Thiel), AgCNS $1{\cdot}25 \times 10^{-6}$ (Abegg). A study of the solubility of silver cyanide in ammonia solution leads to the rather remarkable conclusion that the undissociated substance in solution has the formula $AgCNNH_3$, and that it ionises according to the equation—

$$2AgCNNH_3 = \overset{+}{Ag(NH_3)_2} + \overset{-}{Ag(CN)_2}.$$

Measurements of the solubility of Ag_2S in KCN yield the value $1{\cdot}66 \times 10^{-17}$ for the solubility of Ag_2S at 25°, and from this the electrolytic potential of sulphur is found to be $-0{\cdot}59$ volt, so that sulphur is seen to possess a very small electro-affinity. The paper is an excellent example of the application of Bödlander's methods for the elucidation of complex-formation. F. G. D.

3322. *Serumtherapy from the Physico-chemical Standpoint.* **E. V. Dungern.** (Zeitschr. Elektrochem. 10. pp. 783–785, Sept. 30, 1904.)—This paper forms the continuation of the discussion on the address by Arrhenius [see Abstract No. 3311 (1904)]. The point which the author raises is that if the same amount of diphtheria bouillon is added to a constant amount of anti-serum in two portions, the resulting mixture is more poisonous than when the addition is made all at one time; and the difference in toxicity depends on the amount of the first addition. The author holds that this is contrary to the mass law equation proposed by Arrhenius, and believes that the diphtheria bouillon contains various constituents which react with different velocities with the anti-toxin, and also that irreversible combination occurs. The author does not agree with the assumption made by Arrhenius that the complications are due to secondary reactions which disturb the chief reaction of the type ammonia—boric acid, but considers that these are important chief reactions, consisting in the combination of anti-toxin with constituents in the diphtheria bouillon (toxon, epitoxonoid). A. F.

3323. *Solutions of Copper in Potassium Cyanide.* **F. Kunschert.** (Zeitschr. Anorg. Chem. 41. 3. pp. 359–376, Oct. 8, 1904. Elektrochem. Laborat. der techn. Hochschule, Braunschweig.)—The composition of the complex cyanides of copper was determined in the following manner: A solution of potassium silver cyanide was divided into two equal parts: the one part was diluted with water, and the other part diluted to the same extent with a solution of cuprous cyanide in potassium cyanide. A cell was then made up consisting of these two solutions and silver electrodes, and from the measurement of the e.m.f. the number of molecules of potassium cyanide combined with one molecule of cuprous cyanide was calculated, the composition of the potassium silver cyanide in the solution being known [see Abstract No. 2347 (1904)]. The results showed that 1 molecule of cuprous cyanide was combined with 2·5–3 molecules of KCN, the number of the latter approaching more nearly to 3 as the concentration of the free KCN in the solution increased. The salt present in concentrated potassium cyanide solution is therefore probably $K_3Cu(CN)_4$; in the diluted solutions this is partially decomposed into $K_2Cu(CN)_3$ and free KCN. Experiments with potassium mercury cyanide in the place of the silver compound gave similar results. This was also proved in another manner by measuring the e.m.f. of concentration cells in which the two solutions contained the same amount of the copper salt, but different amounts of KCN, using electrodes of copper amalgam, since the values obtained with copper electrodes varied considerably. Measurements of cells made of Cu (or copper amalgam)—potassium cuprous cyanide solution—normal electrode, gave that the potential difference of copper against a solution of the complex salt is given by the equation $E = 1{\cdot}130 - 0{\cdot}0575 \log D/(CN)^4$, where D is the concentration of the complex salt, and CN that of the cyanogen ions. (Differences were observed between electrodes of copper and of copper amalgam.) Consequently copper will dissolve in a solution of potassium cyanide with evolution of hydrogen, even when the solution in consequence of the reaction—

$$Cu + 4CN' + H_2O = Cu(CN)_4''' + OH' + H,$$

becomes so alkaline that the concentration of the OH′ ions is normal. The tendency for the evolution of hydrogen is less than in the case of zinc, where $E = 1{\cdot}287 - 0{\cdot}029 \log D/(CN)^3$, but, nevertheless, copper electrodes are less stable than zinc, since the supertension of the hydrogen is only 0·23 in the case of the former, whereas with the latter it is 0·7 volt. Theoretically the e.m.f. of the cell Zn—KCN solution—Cu must become less as the concentration of the potassium cyanide is increased; this was proved by experiment. This is of importance in the electro-deposition of brass; with moderate concentration of potassium cyanide and very small current density copper only is deposited; only when the current density is increased is brass deposited. The concentration of the copper ions in a solution which is normal with regard to CN′ ions, and 0·1 normal for the complex salt is 5×10^{-29}. This explains why sulphuretted hydrogen will not precipitate the sulphide of copper from such a solution, since the solubility product of cuprous sulphide is never reached. The stability constant ($= D/[Cu][CN]^4$) of the complex $Cu(CN)_4'''$ is found to be 2×10^{27}, and its energy of formation from the constituent ions is 36,300 cals. Both these values are greater than the corresponding ones for the zinc complex. T. S. P.

3324. *Migration of the Ions in Methyl Alcohol Solutions.* **C. Dempwolff.** (Phys. Zeitschr. 5. pp. 637–641, Oct. 15, 1904.)—To supply the dearth of data even after Carrara's determinations of transport numbers for certain salts in solution in methyl alcohol, the author has extended Carrara's work to the following substances, viz., KCl, KBr, KI; LiCl, LiBr; NaF, $Na(CH_3)O$; $AgNO_3$. The measurements were made by Hittorf's method in an apparatus without a porous partition. The following are the results for potassium iodide:—

Number of Litres in which a gm.-Molecule was Dissolved.	Transport Number of the Anion (Iodine).
2·98	0·49
6·00	0·44
12·50	0·37
20·34	0·33
52·87	0·32

As the dilution is increased the relative migration velocity of the halogen ion rapidly diminishes, till at a certain stage it becomes constant. Quite similar results were obtained with the other substances examined. We may conclude therefore, generally, that as in aqueous solutions, so in methyl alcohol, the transport numbers tend towards a limit. The author supplies a table of equivalent electrical conductivities for the above-mentioned substances in methyl alcohol, to prove that, at any rate for solutions of potassium chloride, potassium iodide, lithium chloride, and lithium bromide, Kohlrausch's law of the independent migration of the ions is still valid when methyl alcohol replaces the aqueous solvent. Finally with the salts KCl, KBr, LiCl, LiBr, the author made concentration batteries, and found that the observed electromotive forces agreed with those calculated from Nernst's formula. D. H. J.

3325. *Combinations of Solvents with Ions.* **J. L. R. Morgan** and **C. W. Kanolt.** (Zeitschr. Phys. Chem. 48. pp. 365–367, June 7, 1904. Translated from the English. Communicated from the Havemeyer Laboratories, Columbia University.)—On electrolysing a solution of silver nitrate and pyridine in water there is a loss of pyridine at the anode and a gain of pyridine at the kathode. When a solution of copper nitrate and water in alcohol is electrolysed the amount of water decreases at the anode and increases at the kathode. This shows that in such solutions certain ions form complex ions with the solvent. It seems that such complex ions involve only one of the solvents. The authors are about to make further investigations to verify the application of the law of mass-action to these phenomena. F. S.

3326. *Electrical Potential of Nickel and Tellurium.* **H. Euler.** (Zeitschr. Anorg. Chem. 41. 1. pp. 93–96, Aug., 1904. Stockholms Högskola.)—The best nickel electrodes are those with a rough, granular surface. They are treated for a short time with dilute sulphuric acid, and used alternately as anode and kathode in a normal nickel sulphate solution. The following are the potential differences obtained:—

$$HgCl \mid n\text{-}KCl - n\text{-}NiSO_4/2 = +0{\cdot}466,$$
$$HgCl \mid n\text{-}KCl - n/_5\text{-}NiSO_4/2 = +0{\cdot}472.$$

Taking the calomel electrode as having a potential of 0·560 volt—

$$Ni \mid n\text{-}NiSO_4/2 = -0{\cdot}094, \quad \text{and } Ni \mid n/_5\text{-}NiSO_4/2 = -0{\cdot}088.$$

Nickel hence comes immediately after lead in the series of electrical potential. The element Te | saturated tellurous acid solution — n-KCl | HgCl gives a zero voltage. T. H. P.

3327. *Electrolysis of Alkaline Chlorides.* **W. Kettembeil** and **C. F. Carrier, Jr.** (Zeitschr. Elektrochem. 10. pp. 561–568, Aug. 5, 1904. Communication from the Inst. für Physikalische Chemie und Elektrochemie d. techn. Hochschule, Karlsruhe.)—An experimental examination of the patent of Gurwitsch (D.R.P., No. 145,749, Sept. 9, 1902). Mercury is used as a kathode and is allowed to impinge in parallel jets on an iron plate. The adhesion between the iron and the alkali amalgam is so great that a thin stream of amalgam issuing from an opening 1/3 mm. diam. will, when it strikes an iron plate, spread out into a stream 12·15 mm. broad. The laboratory electrolyser used by the authors consisted of a bell jar containing a saturated solution of KCl. The anode was a platinum sheet usually enclosed in a porous pot. This was placed at the side, whilst an iron plate inclined at an angle of about 60° constituted the kathode. At the bottom of the jar a layer of chloroform was placed which protected the amalgam that collected there from the electrolyte above. The current efficiency was ascertained by the use of a copper voltameter in the circuit, and by a titration method as used by Glaser in his experiments on the Solvay-Kellner process. [See Abstract No. 686 (1903).] The following table exhibits the general character of the observations :—

CURRENT DENSITY AT KATHODE 0·5 AMP./SQ.CM.

No. of Experiment.	Time in Secs. of 100 c.cm. of Mercury Flowing.	Current Efficiency of Potassium in Per Cent.	Remarks.
72	70	22·15	Electrode freshly amalgamated.
73	60	71·3	Hg flowing through 9 openings.
74	62	68·20	„ „
76	42	92·99	5 openings of 2 mm. diam.
85	120	45·29	Ni electrode new.
86	40	81·39	„
88	35	50·4	Ni electrode, no diaphragm.
89	75	69·3	Fe electrode, fresh amalgamated.

Thorough amalgamation of the iron or nickel plate is very important and difficult to secure. The chief loss of alkali is due to the mercury taking up a wave-like motion, causing the amalgam to be brought in contact with new portions of the electrolyte. C. F. Carrier, Jr., continued the investigation at this point, and used as electrode an iron plate 2 mm. thick on which grooves 1 mm. broad and 1·5 mm. distance from each other were made by means of a three-cornered file. The parts on which the mercury did not flow were carefully insulated. Acheson graphite was used for the anode, and the iron plate was placed at an angle of about 35° from the horizontal. The conclusion is reached that a good efficiency without a diaphragm can only be attained if the surface of the mercury is at rest, or has only a slow and uniform motion. With the present form of the apparatus the efficiency without diaphragm is too small, and with diaphragm the voltage is too great and the arrangement too complicated. W. W. H. G.

3328. *Material and Shape of Rotating Kathodes.* **H. E. Medway.** Amer. Journ. Sci. 18. pp. 180–182, Sept., 1904. Contribution from Kent Chemical Lab. of Yale University.)—Experiments with silver, nickel, and aluminium crucibles in place of the platinum rotating kathode used in previous work on the electrolytic determination of metals [see Abstracts Nos. 456 and 2797 (1904)], show that in the estimation of copper, a silver electrode gives very good results, the deposited metal being easily removed with only trifling loss. Nickel is not so satisfactory, owing to its ready oxidation, and a considerable amount of nickel is lost in removing the copper. Substitution of aluminium for platinum, as recommended by Hough, is useless, probably owing to the film of oxide always present, and attempts to remove this by treatment with hydrochloric acid and the addition of hydrofluoric acid to the electrolyte have proved unavailing. With disc kathodes the best results are obtained, using as anode a strip of platinum extending across the cell under and parallel to the rotating disc, the deposit formed on the top when a semicircular platinum wire anode is employed tending to break off under the rapid rotation of the disc. The crucible form of kathode is considered the better, there being less difficulty with it in drying and weighing the deposited metal. W. H. St.

3329. *Electrolysis of Potassium Acetate.* **F. Foerster** and **A. Piguet.** (Zeitschr. Elektrochem. 10. pp. 729–736, Sept. 16, 1904. Elektrochem. Laborat. d. techn. Hochschule, Dresden.)—Most observers have used smooth platinum electrodes for this electrolysis. The author used a platinised platinum kathode, with an anode of some other material, and an electrolyte of 45 per cent. potassium acetate solution. With an iridium anode the same products are obtained as with smooth platinum, viz., ethane and carbon dioxide. With a platinised anode previously polarised as a kathode, no ethane is produced, but oxygen and carbon dioxide with some carbon monoxide. If this anode is first polarised as an anode, little oxygen and carbon monoxide, some ethane, and much carbon dioxide, are produced. Smooth iron gives oxygen and carbon dioxide; palladium, oxygen, carbon dioxide, and a little carbon monoxide. The e.m.f. across the cell greatly influences the nature of the reaction. F. S.

3330. *Electrolytic Separation of Metals Decomposing Water from Aqueous Solutions.* **A. Siemens.** (Zeitschr. Anorg. Chem. 41. 2. pp. 249–275, Sept. 22, 1904. Extract of Dissertation. Institut für physik. Chemie, Göttingen, May, 1904.)—Magnesium can be deposited with nickel from an aqueous solution if the concentration of the magnesium salt is great. With a small magnesium concentration, especially in presence of ammonium salts, a quantitative separation of nickel from magnesium is possible. The influence of concentration, temperature, and current density on the deposition of nickel magnesium were studied. Magnesium can be deposited just as well with cobalt, not so well with iron, and only in traces with zinc. Aluminium and the metals of the alkaline earths are not generally deposited with the heavy metals from aqueous solutions. The alkali metals are deposited in small but recognisable amounts from aqueous solutions with nickel and tin, but not with iron and silver. No definite alloys are obtained, but the heavy metal appears to act as a solvent for the lighter one. The high potential of the deposit from a mixed salt solution indicates the separation of a "dissolved" light metal. Nickel magnesium sulphate forms no complex ions in aqueous solution. The metals of the alkalies and alkaline earths can be separated from an acetone solution of their salts, but not aluminium, magnesium, and beryllium. F. S.

3331. *Kathode Material and the Reduction of* m- *and* p-*Nitrotoluene.* **W. Löb** and **J. Schmitt.** (Zeitschr. Elektrochem. 10. pp. 756–764, Sept. 23, 1904. From the Bonner chem. Universitätslaborat. Extract of Dissertation.)—That the kathode material has an important effect on the reduction of nitrobenzene has already been shown. Haber and others have demonstrated that within certain limits a definite kathode potential corresponds to a definite reduction energy. [See Abstracts Nos. 2068 and 2071 (1904)]. The authors used a kathode cell consisting of a porous pot of about 350 c.cm. capacity fitted with a stopper. Through this passed a delivery tube and a rod carrying the kathode, which acted as a stirrer, the whole arrangement being gas-tight [see Abstract No. 191 (1901)]. The hydrogen evolved during reduction could be measured and compared with that evolved in a hydrogen voltameter in the same circuit. Two per cent. sodium hydrate solution was used in the kathode cell, and saturated sodium carbonate solution outside. The reduction of the nitrotoluene was continued till hydrogen was given off at the same rate in the voltameter and kathode cell. Curves are given showing the variation of the current yield with the time. The following table summarises the results:—

Kathode.	5 gm. substance taken.							
	m-Nitrotoluene.				*p*-Nitrotoluene.			
	Ni.	Zn.	Cu.	Cu + Cu Powder.	Ni.	Zn.	Cu.	Cu + Cu Powder.
Highest observed percentage of current yield	62·5	94·5	100	100	100	100	100	100
Number of hours for which current yield was 100 per cent..................	—	—	$3\frac{1}{6}$	4	$2\frac{3}{4}$	$3\frac{1}{2}$	4	$4\frac{3}{4}$
Percentage of hydrogen used in reduction out of total amount produced by current	36·86	46·5	54·3	61·87	46·92	56·25	64·33	71·23
Yield in gm. Azoxytoluene	2·47	2·42	1·83	1·38	2·66	2·52	2·10	1·70
Do., Azotoluene......	—	—	—	—				
Do., Tolidine or Semidine	0·36	0·29	0·24	0·17	0·19	0·15	0·11	0·05
Do., Toluidine	0·46	0·56	1·16	1·68	0·67	0·88	1·34	1·83

F. S.

3332. *Influence of Indifferent Ions on the Formation of Periodates by Electrolysis.* **E. Müller.** (Zeitschr. Elektrochem. 10. pp. 753–756, Sept. 23, 1904. Elektrochem. Laborat. d. techn. Hochschule, Dresden.)—It has been shown by the author that the transformation of iodates to periodates hardly proceeds with a smooth platinum anode, but is greatly helped by the presence of indifferent ions such as Cl′, SO_4'', and ClO_4' [see Abstract No. 1238 (1904)]. With these ions the process cannot be quantitatively followed. The author then found that the yield of periodate could be raised to 30 per cent. by the addition of sodium or potassium fluoride. He then made a cell with platinum electrodes, the anode being in iodic acid solution, and separated from the kathode in dilute sulphuric acid by a rubber sponge. The anode potential was measured from time to time. When hydrofluoric acid was added to the anode cell there was a sharp increase of potential and the yield of periodate reached 31 per cent. The reaction-resistance being raised in this way, the formation of oxygen on the anode is hindered. The yield of periodate can be increased by the use of a lead peroxide anode, and in this case the anode has a much lower potential. F. S.

3333. *Preparation of Persulphates.* **E. Müller.** (Zeitschr. Elektrochem. 10. pp. 776–781, Sept. 30, 1904. Elektrochem. Laborat. d. techn. Hochschule, Dresden.)—Potassium or sodium sulphate in aqueous solution is electrolysed between platinum plates with the addition of sulphuric and hydrofluoric acids. The potassium persulphate crystallises out on the anode; the yield is not greatly affected by the addition of hydrofluoric acid. But with sodium sulphate the yield of persulphate is markedly increased by adding hydrofluoric acid during the electrolysis. If a solution of potassium bisulphate is electrolysed the anode potential reaches a certain value which is raised by the addition of hydrofluoric acid. The author discusses Skirrow's work on the electrolysis of hydrofluoric acid with sulphuric acid. [See preceding Abstract and Nos. 526 (1903) and 212 (1904).] F. S.

3334. *The Lead Voltameter.* **A. G. Betts** and **E. F. Kern.** (Electrician, 54. pp. 16–18, Oct. 21, 1904. Metallurgie, 1. pp. 430–433, Oct. 22, 1904. Abridgement of paper read before the St. Louis International Electrical Congress.)—The authors commence by expounding, in the order of their scientific importance, the merits and demerits of existing voltameters, at the same time pointing out that it is not their intention to try and replace the silver voltameter by the lead voltameter, but to describe the latter, and show wherein it possesses features which might be a means of its replacing the copper voltameter for technical purposes, such as in calibrating electrical instruments, and for comparison of the electro-efficiency of electro-chemical methods. Details of their research work are then given, the general conclusions arrived at being: (1) That the better form of voltameter is one with two anodes and one kathode. (2) The deposit which forms, even with high current densities (20 to 25 amps. per sq. ft. of kathode exposure in a fairly strong electrolyte), is perfectly smooth, dense, and non-crystalline, so long as the electrolyte contains about one part of gelatine by weight in 2,000 to 4,000 parts of solution. Gelatine is employed by the authors as a reducer, and they state that the moment it is added crystallisation of the lead is prevented. (3) The current density, used within fairly great limits in the lead voltameter, does not affect the results. The limit of the current-density seems to be controlled by the strength of the electrolyte and by its circulation. (4) The lead voltameter is well adapted for obtaining electro-chemical efficiencies of experiments which require long duration. (5) From an electro-chemical point of view the lead voltameter has an advantage over the silver voltameter, in that lead stands very high in the e.m.f. series, so that impurities which are ordinarily contained in refined lead will remain as "sludge" on the anode, whereas the purest silver is required for the construction of a silver voltameter. (6) Another obvious advantage of lead over silver is its cheapness, so that with a small outlay a lead voltameter of any size may be constructed. A very complete table is included of the electro-equivalent weights of the various metals which deposit on the kathode. The results given are those obtained by comparing the lead voltameter with the silver voltameter. The authors conclude by stating that the paper is far from complete, and that more work needs to be done in order to develop the possibilities of this innovation. J. L. F. V.

REFERENCES.

3335. *Chemical Action of Light.* VII. **G. L. Ciamician** and **P. Silber.** (Ber. Deut. Chem. Gesell. 36. pp. 4266–4272, 1903.)—The polymerisation of cinnamic acid to α-truxillic acid by the action of light only takes place with the solid acid. Both solid coumarin and its solutions, however, yield dihydrocoumarin. Exposed in a dessicator to air and light, stilbene gives a sublimate of benzoic acid; the stilbene may be regarded as a peroxide which decomposes into benzaldehyde, the latter being then partially resinified and partly oxidised. Both solid and aqueous maleic acid slowly yield fumaric acid in the light. *o*-Nitrobenzylideneaniline gives *o*-nitrosobenzanilide, but with nitrobenzaldoxime the anti-oxime is converted into the syn-form. Similarly the anti-modification of *p*-nitrobenzaldoxime yields the syn-compound, but the *m*-oxime is unchanged. The esterification of opianic acid by ethyl alcohol occurs in absence of light, but not so quickly as in sunlight. T. H. P.

3336. *Microchemical Detection of Gold.* **J. Donau.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2b. pp. 180–189, Feb. and March, 1904. From the Laborat. für allgem. Chemie an der k. k. techn. Hochschule in Graz.)—Raw silk fibre is treated with caustic alkali and well washed. A fibre is then soaked in a solution of tannin or pyrogallol and stannous chloride, and washed once. If a drop of a neutral or acid solution containing gold chloride is placed in contact with this fibre, it is coloured red by the gold, probably in a colloidal form. This reaction is extremely delicate. The metals cobalt, silver, cadmium, arsenic, antimony, and platinum (in large proportions) interfere with the reaction. F. S.

3337. *Radium in Monazite Sand.* **L. Haitinger** and **K. Peters.** (Akad. Wiss. Wien, Sitz. Ber. 113. 2a. pp. 569–570, May, 1904. Laborat. der oesterreich. Gasglühlicht und Elektrizitäts-gesell. in Atzgersdorf bei Wien.)—Considerable quantities of thorium nitrate having been precipitated by ammonia from Brazilian monazite sand, 50 kg. of carbonates, mostly Ca, were obtained from the filtrate, and from these 150 gm. of a radio-active sulphate isolated and further treated. The radio-activity of part of the substance, left to itself for two years, increased. The radium, which was spectroscopically identified, seems to come from the small portion of uranium in the monazite, and attention is drawn to this combined occurrence of thorium and radium. The monazite is not a promising source for the preparation of radium. H. B.

3338. *Intermolecular Change in the Stereoisomers α and β Trithioacetaldehyde and α and β Trithiobenzaldehyde.* **J. F. Suyver.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 104–110, July 13, 1904. Proc. 7. p. 329, Nov. 23, 1904.)—Many substances cause the transformation, and various methods were tried to get efficient separation of the isomers. HCl appears to be the best catalyser for the first, iodine for the second pair (α to β). H. H. F. H.

3339. *Crystal Structure and its Relation to Chemical Constitution.* **P. Groth.** (Chem. News, 90. pp. 142–144, Sept. 16, 1904. Paper read before the British Association, at Cambridge.)—A discussion of modern work on the crystallographic relations of chemically allied substances in connection with Sohncke's theory of crystal structure. The paper does not admit of a brief Abstract. F. G. D.